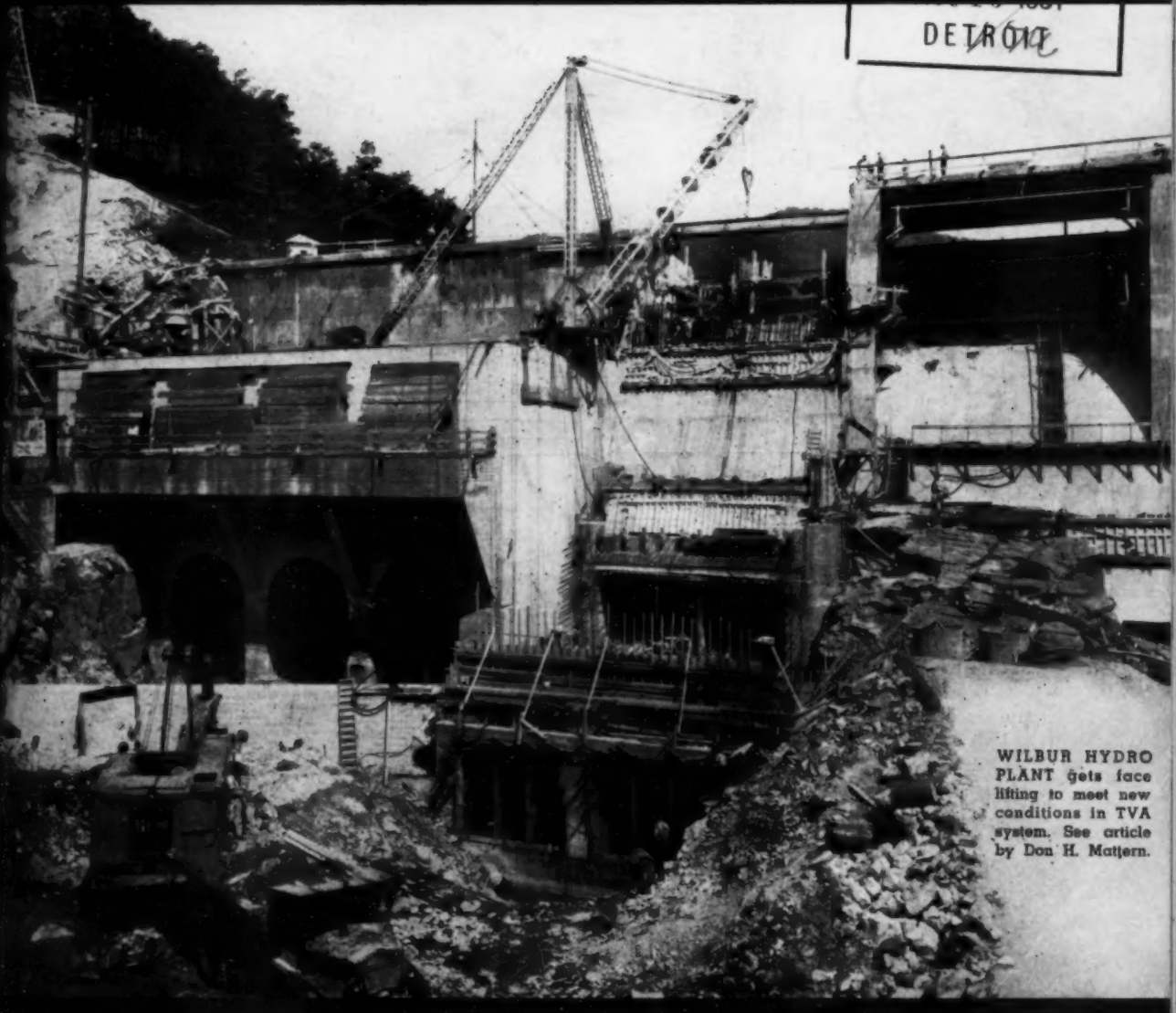
CIVIL ENGINEERING

DETROIT



WILBUR HYDRO PLANT gets face lifting to meet new conditions in TVA system. See article by Don H. Mattern.

Raymond MAKES 5 TYPES OF CONCRETE PILES

1. STANDARD . . . 2. STEP-TAPER . . .
3. PIPE STEP-TAPER . . . 4. COMPOSITE
5. GOW CAISSONS

Raymond installs every type of pile: cast-in-place concrete, precast concrete, steel pipe, wood and H-beam. Raymond operations include underpinning; borings and soil investigations; waterfront construction and harbor and river improvements; shipbuilding facilities; also cement-mortar lining of water, oil, gas and chemical pipelines, 4" to 144" diam's., by Centriline Corp., a Raymond subsidiary.

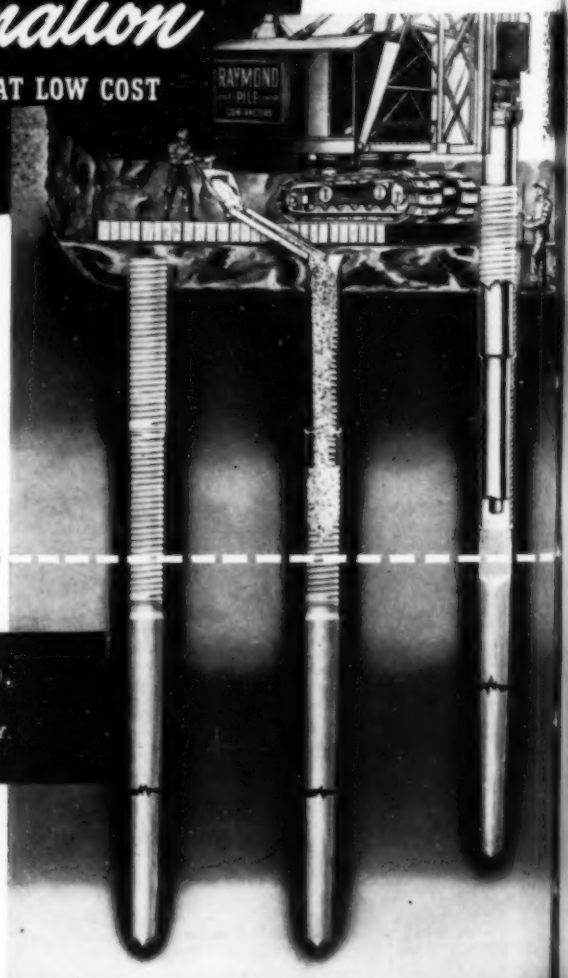
DIMENSIONS OF RAYMOND WOOD COMPOSITE PILES
DIAMETERS SHOWN O.D. OF SHELL
STEP-TAPER SECTIONS FOR TENON TYPE COMPOSITE PILES USUALLY START WITH NO. 4 OR NO. 5
STEP-TAPER SECTIONS FOR WEDGE TYPE COMPOSITE PILES USUALLY START WITH NO. 2 OR NO. 3
WOOD SECTION ANY LENGTH
16 FT.
24 FT.
32 FT.
40 FT.
48 FT.

4. COMPOSITE PILES

The right combination

FOR LONG LENGTH AT LOW COST

Right, driven wood pile is being followed down by pile shell of concrete section. Center, complete pile driven to resistance, pile shell is being filled with concrete. Joint, wedge-type with sealing ring, is below ground-water level. Completed pile is shown at left.



Raymond Composite Piles are used for economy and long length. The concrete upper section extends from the permanent water table up to the underside of the footing, thus eliminating the expensive excavation, sheeting and pumping often required with wood piles.

Raymond Composite Piles have solved many deep foundation problems permanently and at minimum final cost. We shall be glad to advise you, without obligation, whether they are suitable for your project.

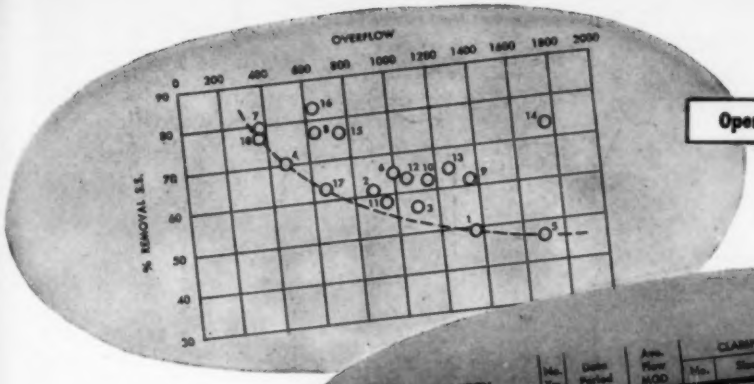
PERMANENT WATER LINE

RAYMOND PILES MAINTAIN DRIVING RESISTANCE

Raymond CONCRETE PILE CO.

140 CEDAR STREET, NEW YORK 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America.



Operating Data on Dorr Sifeed Clarifiers—

radial flow—round or square units. Chart graphically illustrates results given in table below.

LOCATION	No. Yrs.	Data Period	Ave. Flow MGD	CLARIFIERS No.	CLARIFIERS Size	W.D.	Det. Hrs.	O'Flow Gal.	SUSP. SOLIDS Sanit.	SUSP. SOLIDS Eff.	SUSP. SOLIDS % Rem.
1 Washington, Blue Plains Pl.	2	1944-45	136.3	12	106' Dia.	14	1.88	1330	163	83	49
2 Gary, Ind.	4	1941-44	20.11	4	75' Sq.	10	2.0	900	365	104	61
3 Winnipeg, Man.	2	1943-44	22.8	2	115' Dia.	12	1.98	1100	348	139	85
4 Battle Creek, Mich.	5	1938-42	4.92	2	80' Dia.	10	2.86	490	282	86	70
5 Buffalo, N. Y.	2	1939-41	135	4	160' "	15	1.6	1490	209	114	46
6 Albuquerque, N. M.	7	1939-46	5	1	80' "	12.2	2.21	995	254	91	64
7 Yakima, Wash.	1	1942	9.3	4	90' "	9	4.32	373	110	23	79
8 Appleton, Wis.	7	1938-45	4.8	2	70' "	10	2.90	623	276	63	77
9 Baltimore, Md.	4	1939-44	89.5	3	170' "	12	1.44	1360	214	83	61
10 Springfield, Ohio	4	1937-40	14.8	2	90' "	10	1.53	1160	166	63	62
11 Mansfield, Ohio	2	1944-45	3	1	45' "	12	2.38	905	208	87	58
12 Cedar Rapids, Ia.	9	1936-44	4.21	1	70' "	11.5	1.95	1060	354	133	63
13 Austin, Texas	2	1944-45	8.64	1	75' "	13	1.69	1275	363	95	64
14 Neenah-Menasha, Wis.	4	1942-45	7.93	2	75' "	10	1.0	1790	681	188	72
15 Denver, Colo.	5	1939-43	46	4	140' "	9.7	2.34	750	187	44	77
16 Sheboygan, Wis.	1	1944	6.4	2	80' "	10	2.8	835	342	60	82
17 Ypsilanti, Mich.	3	1943-45	1.66	2	40' "	9	2.5	660	226	57	62
18 Monroe, Mich.	8	1938-46	4.3	2	80' "	7.5	3.85	378	329	75	77

check these facts ON DORR SIFEED CLARIFIER PERFORMANCE

A few moments' study of this graph and the supporting table will give you a clear idea of what kind of performance you can expect Dorr Clarifiers to deliver.

- ***These are long term records . . . obtained by competent plant chemists at well established installations. We believe they cannot be equaled.***
- ***Performance is one of the primary factors upon which Clarifier excellence should be judged. Are you getting the best?***

We'd like to give you some figures on Dorr Clarifier repair costs too. Ask a Dorr engineer for the facts.

Sifeed is a trademark of The Dorr Company, Reg. U. S. Pat. Off.

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DORR

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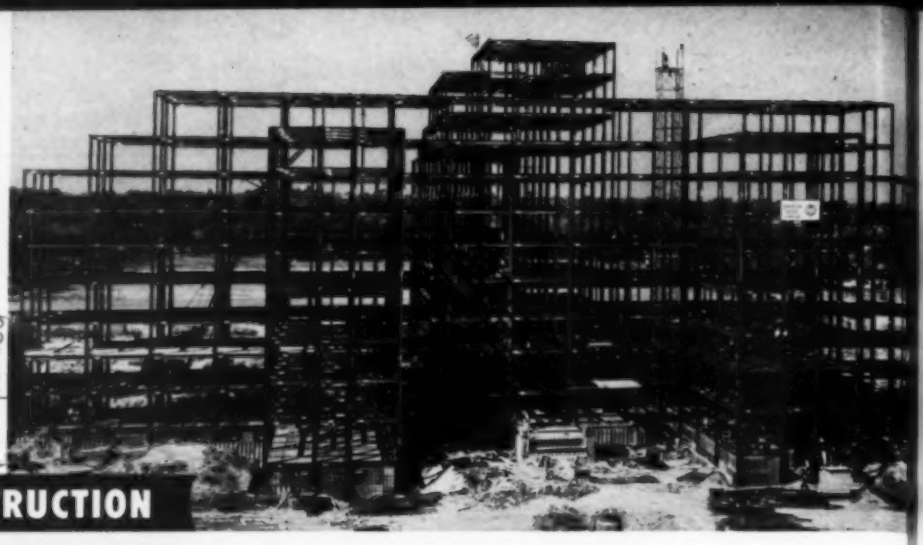
THE DORR COMPANY · ENGINEERS · STAMFORD, CONN.

Associated Companies and Representatives in the principal cities of the world

CIVIL ENGINEERING, The Magazine of Engineered Construction, August, 1951. Vol. 21, No. 8. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

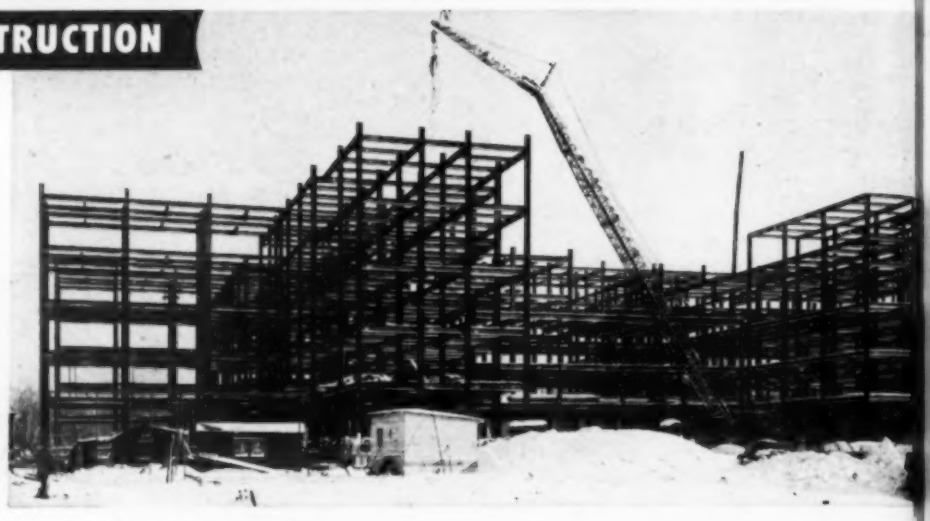
VETERANS ADMINISTRATION HOSPITAL, DENVER, COLORADO. American Bridge Company fabricated and erected the structural steel for main hospital building, 329' x 329', 9 stories high with penthouse; also the boiler house, the chapel, manager's building, apartment building, nurses' quarters and attendants' quarters. Total weight, 2,600 tons. General Contractor, Del E. Webb Construction Co. Plans by Veterans Administration Construction Service.



RIVETED CONSTRUCTION

WELDED CONSTRUCTION

VETERANS ADMINISTRATION HOSPITAL, MINNEAPOLIS, MINNESOTA. Fabricated and erected by American Bridge Company. Project included hospital building No. 43—an 8-story structure, with setback and penthouse, and #43-1, an 11' wide x 76' long, 4-story connecting corridor, and a 61' x 117' x 13' 8" addition to laundry building. Hospital building #43 was of welded construction throughout. Total weight of steel, 2,100 tons. General Contractor, J. D. Hedin Construction Company. Plans by Veterans Administration Construction Service.



Steelwork for both hospitals

FABRICATED AND ERECTED BY

AMERICAN BRIDGE COMPANY

AS SPECIFIED

THE two big hospitals shown above are typical of the many steel buildings fabricated and erected by American Bridge Company. Each is a good example of its particular type of construction.

American Bridge Company plays no favorites when it comes to riveted or welded construction. We have the skilled personnel and equipment to do both types with exacting precision, thoroughness and speed. The all-welded Minneapolis job was erected during the severe Minnesota winter and is evidence of the willingness and ability of American Bridge Company to field-weld structures any time, anywhere!

If you would like to know more about the advantages of American Bridge Company fabricated and erected steel construction, just call our nearest office.

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Contracting Offices in: AMBRIDGE · BALTIMORE · BOSTON · CHICAGO · CINCINNATI CLEVELAND · DENVER · DETROIT · DULUTH · ELMIRA · GARY · MINNEAPOLIS · NEW YORK PHILADELPHIA · PITTSBURGH · PORTLAND, ORE. · ST. LOUIS · SAN FRANCISCO · TRENTON UNITED STATES STEEL EXPORT COMPANY, NEW YORK

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UNITED STATES STEEL

These Liner Plates are "ALL MUSCLE"

There is no "fat" on Armco Liner Plate.

All excess weight and bulk has been eliminated. Corrugated metal design provides safe strength with less material. It saves metal and money. This is why Armco Liner Plates cost less to carry a given load than any other type.

Installation is simplified too. The high strength to weight ratio means that Armco Liner Plates are easy to handle. One man can carry, hold and bolt a section into place. Less bulk also means less excavation. Jobs are completed quickly and economically.

Other advantages of Armco Plates include fire-resistance and freedom from future maintenance expense. Use them with confidence for placing new openings or relining existing structures. Write for complete information. Armco Drainage & Metal Products, Inc., 4061 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

ARMCO

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"BIG RED" DIGS IN. The International TD-24 dozes through tough going faster, pushes bigger bladefuls farther, moves more pay-dirt per day. It's the "Champ" for sure!

Read what makes International's TD-24—the Big Red "Champ"—finish ahead of the field!

Man or machine, it takes speed and strength and stamina to take on all comers and leave 'em trailing behind. It takes guts and power to spare to be the "Champ."

In a human, it means running a faster race, hitting a harder ball, fighting a tougher fight. In the TD-24, it means doing more work in less time than any other crawler on the market.

More speed—8 forward and 8 reverse speeds up to 7.8 mph for faster time cycles on the job.

More power—148 maximum drawbar horsepower—to take a bigger load on the scraper, a bigger bite on the blade and move dirt faster, easier, cheaper.

More flexibility—synchromesh shifting "on the go"—instant change up or down one speed without declutching—Planet Power steering for pivot turns, feathered turns, turns with power on both tracks.

The TD-24 gets in and out and back in again faster—moves more dirt each time—makes more money for its owner every working day.

It's the Big Red "Champ" any way you look at it.

Come in and look. Ask your International Industrial Distributor for the low-down. Find out about his fast-moving parts and service setup, which will keep your International power on the job for years to come. You'll be a TD-24 man from then on in!

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

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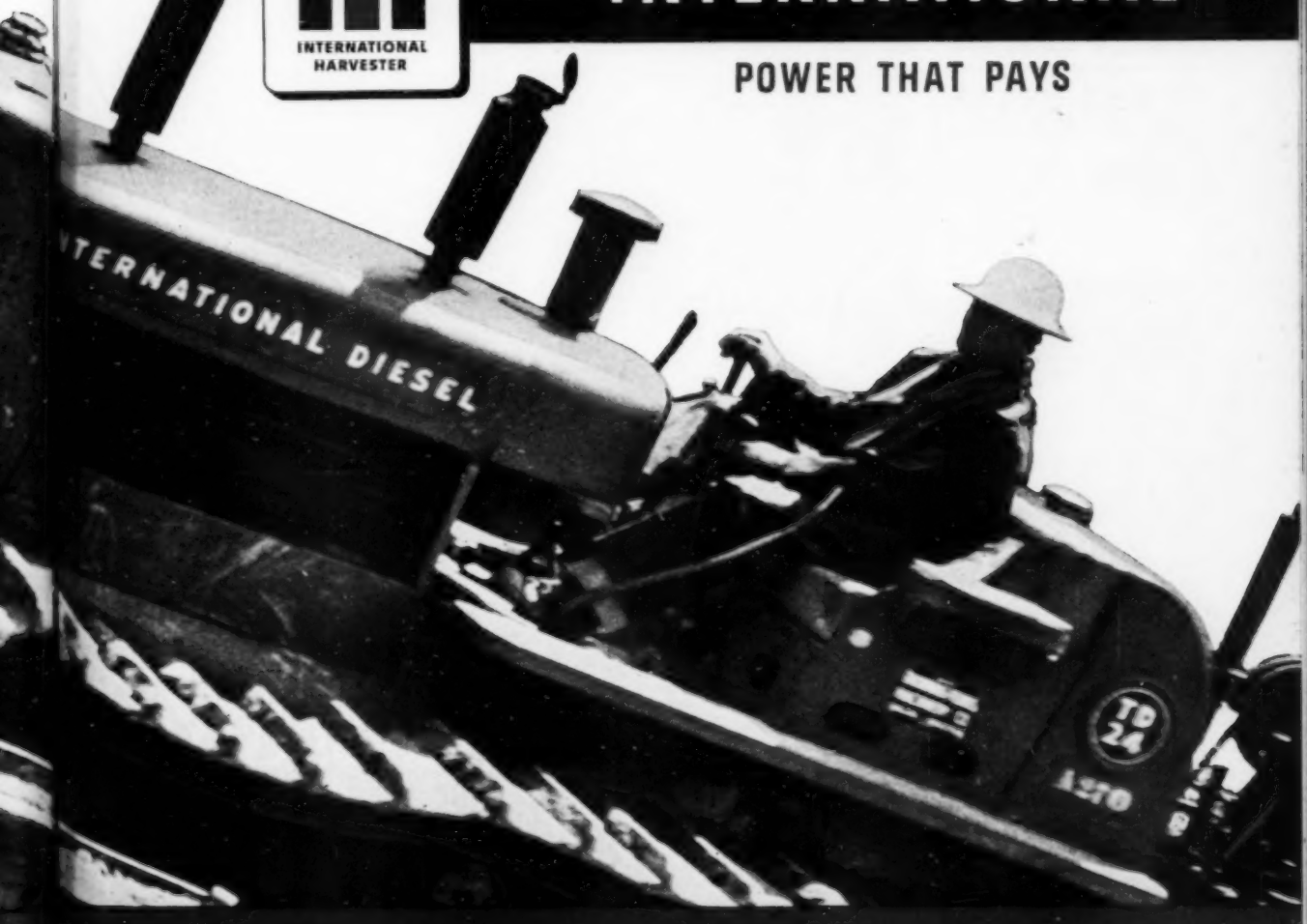
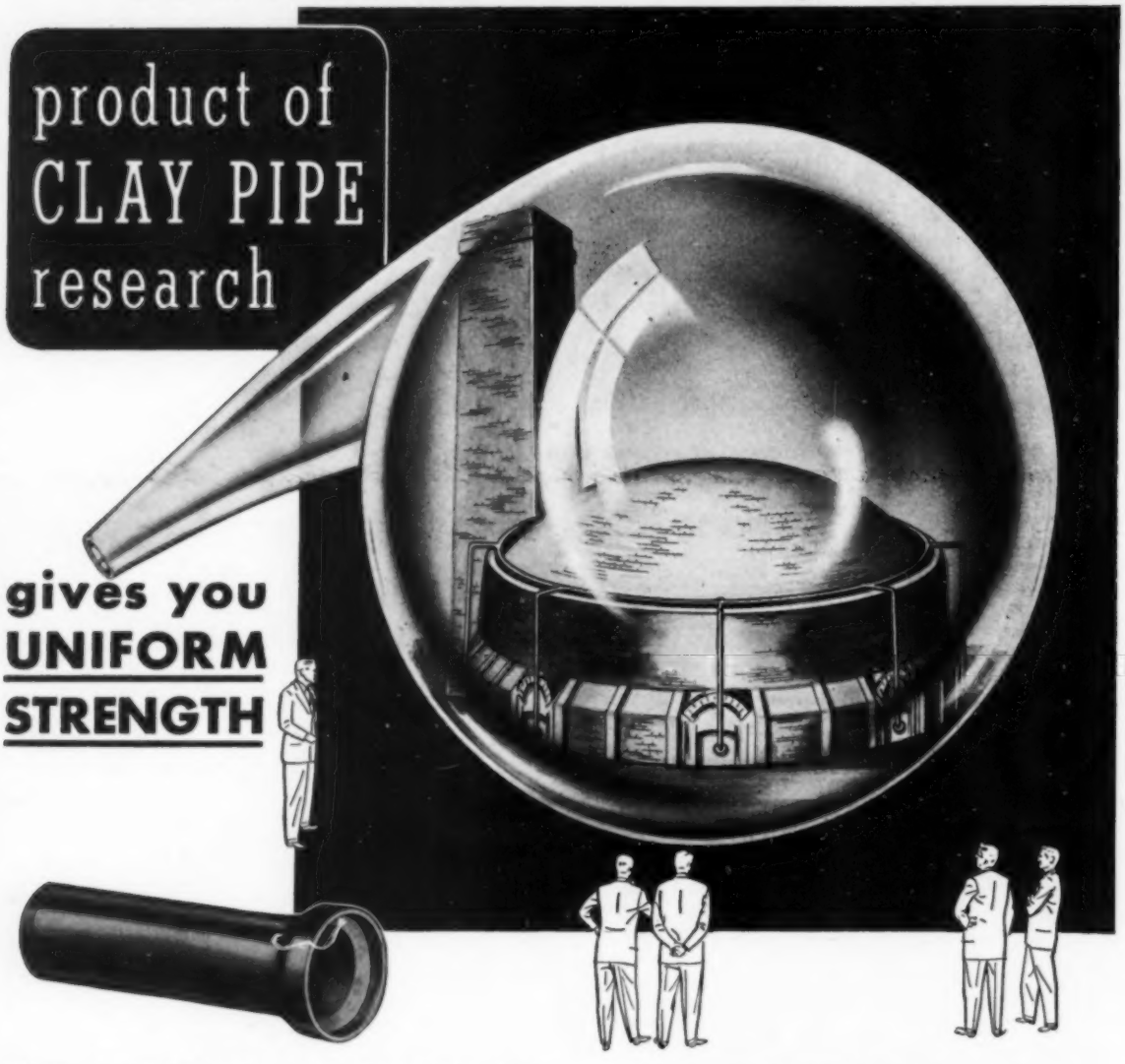
POWER THAT PAYS



controlled firing...

product of CLAY PIPE research



gives you UNIFORM STRENGTH

CONTROLLED FIRING . . . is a factor behind the *uniformity* of Vitrified Clay Pipe — whether it's one length, or a million. Electronic instruments correctly balance Clay Pipe firing time and temperature. This modern technology, harnessed to govern manufacturing processes, *improves* Clay Pipe's basic quality. Clay is chemically inert, completely unaffected by corrosion or the chemical wastes of modern industry. It's the *best* pipe for *your* sewerage or drainage projects.

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C-151-11

ENGINEERED TYING DEVICES, ANCHORAGES and ACCESSORIES for CONCRETE CONSTRUCTION

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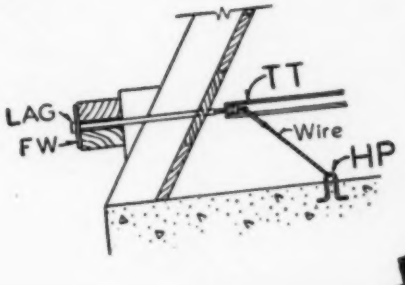
The Richmond Tie Down Tyscru offsets any tendency towards uplift of the form where construction is off the perpendicular. It is a standard 2-strut Tyscru with a 45° Tie Down Loop at one or both ends. The loop is wired to a Hairpin or Ty-Loop imbedded in the footing. Particularly useful where extreme batter tends to cause an uplift in the form.



PIPE THE BABE— WILL 'YA— WHAT A SHAPE!
OH BOY! IT WOULD SURE BE A SHAME TO TIE THAT DOWN.
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INSIST ON RICHMOND
... AND BE SURE IT'S RICHMOND!
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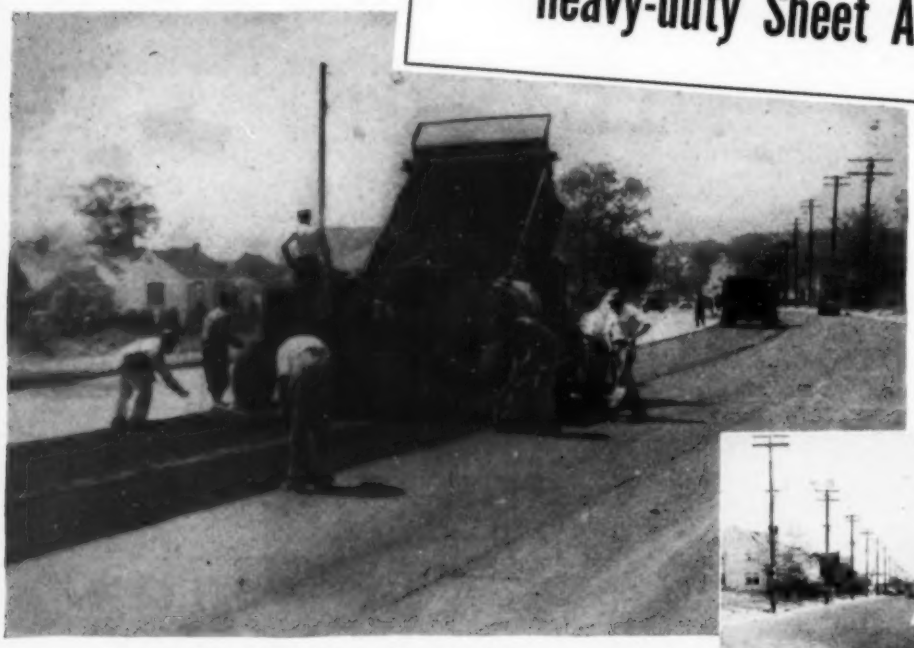
RICHMOND KNOW-HOW—DEPENDABILITY—SERVICE—ESTIMATES & JOB PLANNING

Where two important State Highways become one . . .

. . . the pavement Rhode Island laid was heavy-duty Sheet Asphalt



Constructing a 3-inch Texaco Sheet Asphalt pavement for the heavy traffic of Reservoir Avenue, Cranston, R.I., Contractor: The Campanella and Cardi Construction Company of Providence.

Two of Rhode Island's principal north-south highways are its Routes 2 and 3. South of the city of Cranston, these highways come together, sending their combined traffic over this municipality's Reservoir Avenue.

This year, the State of Rhode Island is widening a substantial portion of Reservoir Avenue to six lanes, then paving it with 114,000 square yards of Texaco Sheet Asphalt. Laid in two courses, in this case a $1^1/_2$-inch binder course and a $1^1/_2$-inch wearing surface, this dense, resilient type of pavement successfully absorbs punishing traffic impact year after year, with a low maintenance cost. This has been demonstrated by the performance of many million square yards of Sheet Asphalt under the heaviest kind of traffic.

The 60-70 penetration asphalt used on Reservoir Avenue, like all other Texaco asphalts, is a product of carefully selected crudes. Into its refining goes the know-how gained through supplying asphalt to America's road builders for 45 years.

A helpful booklet about Sheet Asphalt and other heavy-duty asphalt pavements of the plant-mix type may be obtained without charge or obligation by writing our nearest office.

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

Boston 16 Chicago 4 Denver 1 Houston 1 Jacksonville 2 Philadelphia 2 Richmond 19

TEXACO

TEXACO ASPHALT

Mechanical soldiers need good shoes, too!

THESE are days of grave concerns . . . of conservation and mobilization for strengthening the nation's defense—for the survival of our national economy—for the continuance of useful highway, airfield, dam-site, reclamation and other construction programs—for the keeping of every home-front machine in condition to stay on the job until its replacement again becomes a normal procedure.

That includes *your* equipment and emphasizes *your* responsibilities. To benefit fully from the productive life that has been built into your "Caterpillar" equipment, you must be alert to its needs as time and hard usage take their toll in wear and depreciation. For instance:

How are your "Caterpillar" track shoes?

Tough as they are, they can't battle rocks, shale, jolts and grinds forever. Growing shortages in the premium steels that go into them may make early replacements difficult—and extra care of track parts something to think about.

CATERPILLAR, PEORIA, ILLINOIS

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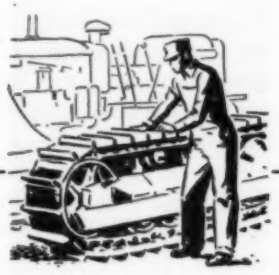

YOU'RE THE DOCTOR. Check those sprockets, grousers, rollers, idlers, pins, links and bushings. Proper track adjustment minimizes wear. Sprockets may need switching from side to side, and pins and bushings need turning, to provide new wearing surfaces. Shoes serve longer if you have worn grousers built up before excessive wear occurs.

Reread your Operator's Instruction Book. Anticipate your future parts requirements. Take the facts to your "Caterpillar" dealer. His modern facilities and skilled servicemen are at your disposal. He can rebuild many parts to keep your machines on the job. Their added life will repay the reconditioning cost over and over.

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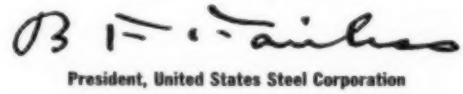
"This is more than a shortage . . . this is an emergency.

Every pound of your scrap is needed, NOW!"

"THE STEEL INDUSTRY is currently operating at more than 100% of rated capacity—turning out well over 2 million tons of steel per week. This record high production—every ton of which is in urgent demand—cannot be kept up unless we get more scrap from every potential source. For without your scrap we cannot produce enough steel. Today, every ton of steel turned out requires a half a ton of scrap for its production. That's why scrap—more scrap—is so urgently needed, and needed right away.

"The fact we have to face today is that steel mills are operating on a hand-to-mouth basis as far as scrap is concerned. Some mills are working on only a two-day supply of scrap. We already have had to shut down steel-making furnaces for lack of scrap.

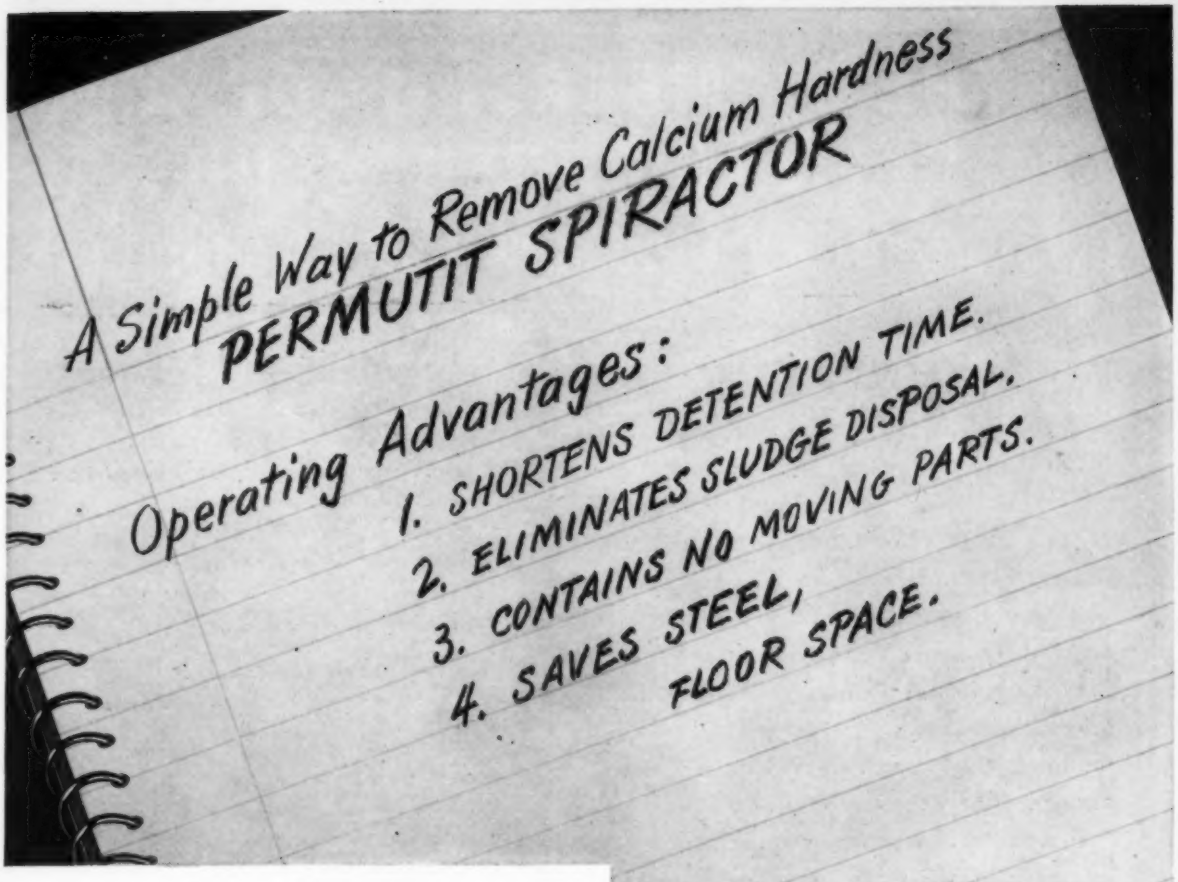
"That's why we are asking you to strain every effort to get more scrap out of your plants and yards and on its way to the mills . . . to search out the scrap that doesn't come to market in normal times. You'll find this "dormant" scrap in obsolete equipment, tools and machinery that you haven't used for years . . . overlooked in your storage sheds . . . or rusting away in a junk pile in some forgotten corner. It's there. Turn it in at once—*so we can turn out the steel you need.* We can't do it without your help."



President, United States Steel Corporation

USS

UNITED STATES STEEL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PERMUTIT SPIRACTOR
Operating Advantages:
1. SHORTENS DETENTION TIME.
2. ELIMINATES SLUDGE DISPOSAL.
3. CONTAINS NO MOVING PARTS.
4. SAVES STEEL, FLOOR SPACE.

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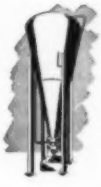

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Accelerated precipitation is possible through intimate contact with solid catalyst granules.

Water swirls upward through the catalyst bed, depositing calcium in layers around the granules. This precipitated hardness is as easy to dispose of as moist sand. The output is soft, stable water.

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C.I.P. Century Club now has 38 Members

The Cast Iron Pipe Century Club is probably the most unusual club in the world. Membership is limited to municipal, or privately-owned, water and gas supply systems having cast iron mains in service for a century or more.

Although the Club is formally constituted, there are no dues, no regular meetings, and no obligations other than to inform the Recording Secretary if and when the qualifying water or gas main is taken out of service, or, sold for re-use.

In spite of the unique requirement for membership, the Club roster grows, year by year. And why not, when a survey sponsored by three water works associations, indicates that 96% of all 6-inch and larger cast iron water mains ever laid in 25 representative cities are still in service. And when answers to a questionnaire, mailed to gas officials in 43 large cities, show that *original* cast iron mains are still in service in 29 of the cities.

If your records show a cast iron main in service, laid a century or more ago, the Club invites you to send for a handsome framed Certificate of Honorary Membership. Address Thomas F. Wolfe, Recording Secretary, Cast Iron Pipe Century Club, Peoples Gas Bldg., Chicago 3, Illinois.

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CLUB ROSTER

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BOSTON CONSOLIDATED GAS CO.
Boston, Massachusetts
BOARD OF WATER COMMISSIONERS
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FALL RIVER GAS WORKS COMPANY
Fall River, Massachusetts
CITY OF FREDERICK WATER DEPT.
Frederick, Maryland
GAS DEPARTMENT
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THE HARTFORD GAS COMPANY
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Mobile, Alabama
WATERWORKS DEPARTMENT
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Philadelphia, Pennsylvania
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BUREAU OF WATER, DEPT. OF PUBLIC WORKS
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QUEBEC POWER COMPANY, GAS DIVISION
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BUREAU OF WATER
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DEPT. OF PUBLIC UTILITIES
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DEPT. OF PUBLIC UTILITIES, WATER DIVISION
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Wheeling, West Virginia
WILMINGTON WATER DEPT.
Wilmington, Delaware
WATER DEPARTMENT
City of Winchester, Virginia
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City of Winston Salem, North Carolina
YORK WATER COMPANY
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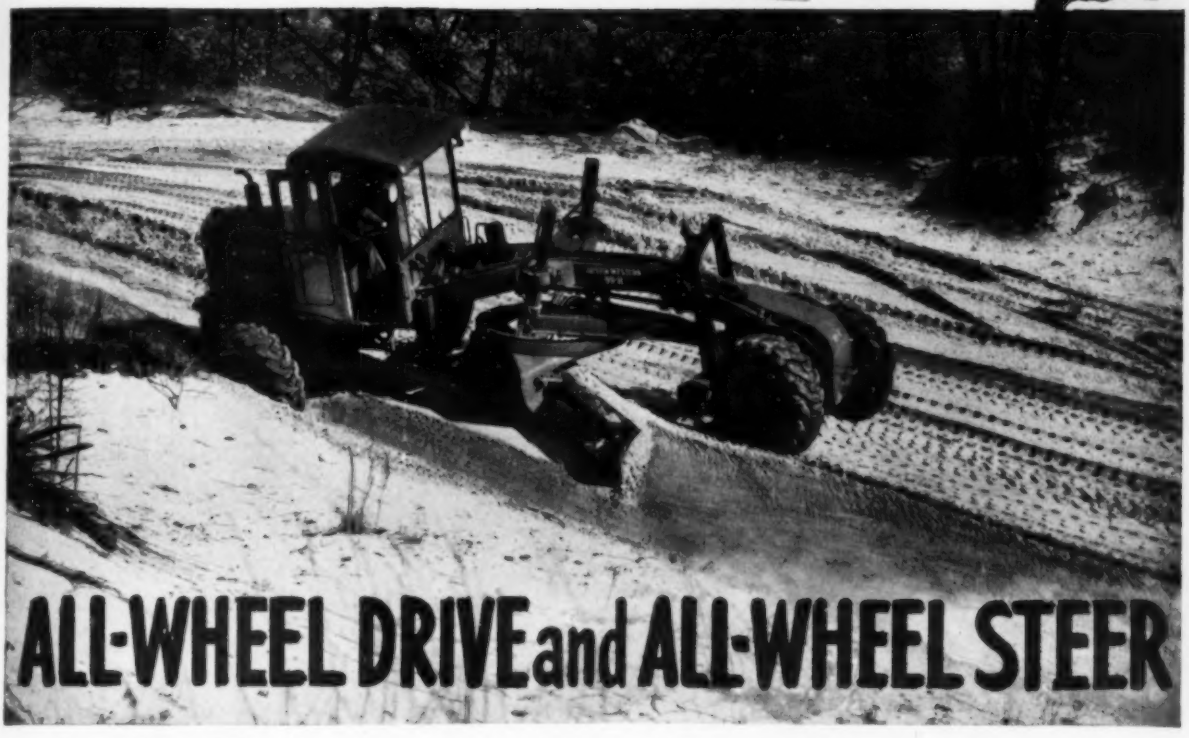
WATER DEPARTMENT
City of Zanesville, Ohio

CAST IRON PIPE SERVES FOR CENTURIES

Like "scotch and soda"—

they Go Together



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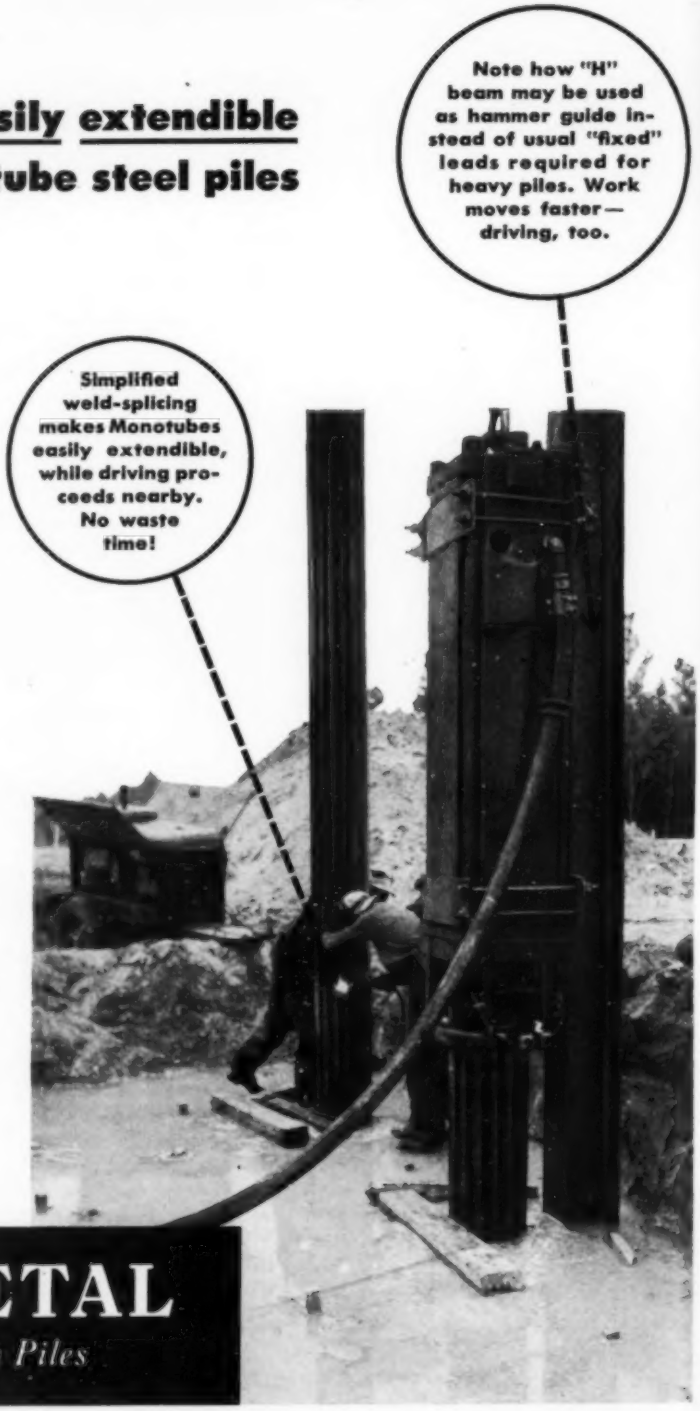
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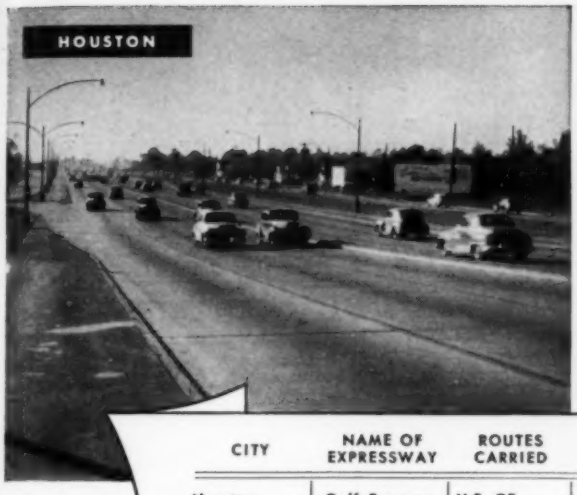
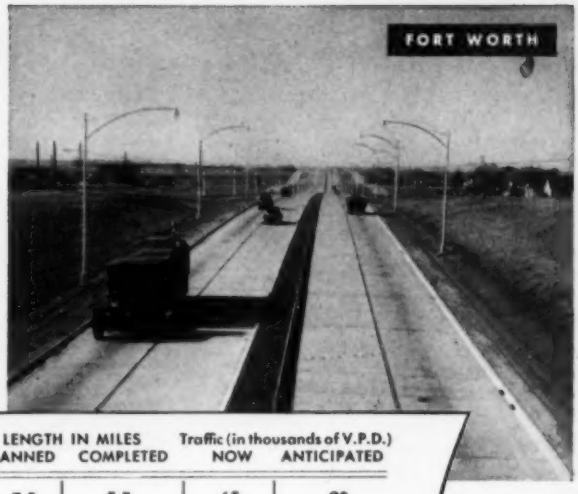
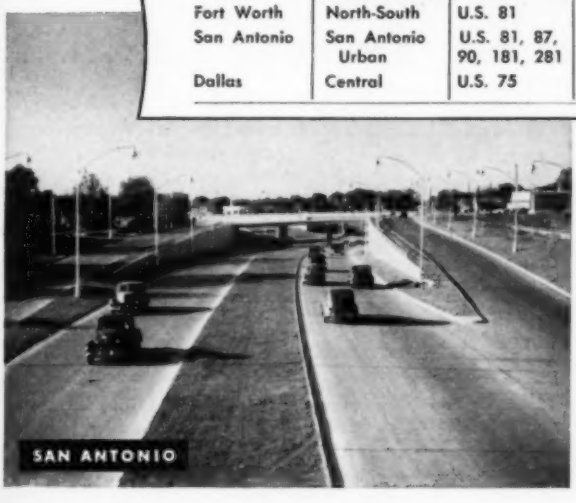
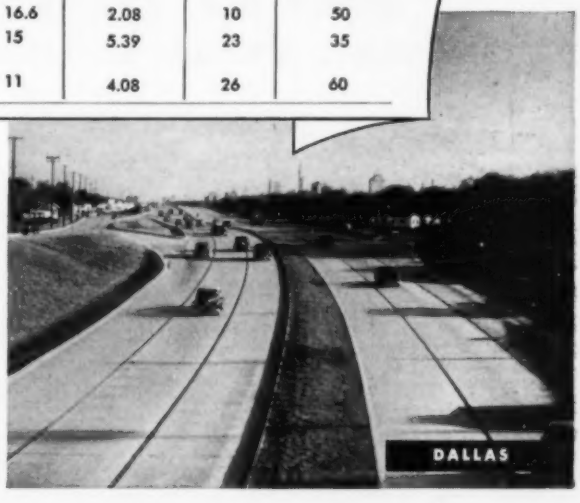




CITY	NAME OF EXPRESSWAY	ROUTES CARRIED	LENGTH IN MILES PLANNED	LENGTH IN MILES COMPLETED	Traffic (in thousands of V.P.D.) NOW	Traffic (in thousands of V.P.D.) ANTICIPATED
Houston	Gulf Freeway	U.S. 75	7.5	5.5	65	90
Fort Worth	North-South	U.S. 81	16.6	2.08	10	50
San Antonio	San Antonio Urban	U.S. 81, 87, 90, 181, 281	15	5.39	23	35
Dallas	Central	U.S. 75	11	4.08	26	60





How Four Texas Cities Are Solving Traffic Problems with

Concrete Expressways

THE photos above show completed sections of four expressways under construction in Texas. They illustrate how these four progressive cities are solving urban traffic problems with concrete expressways to meet today's—and tomorrow's—needs.

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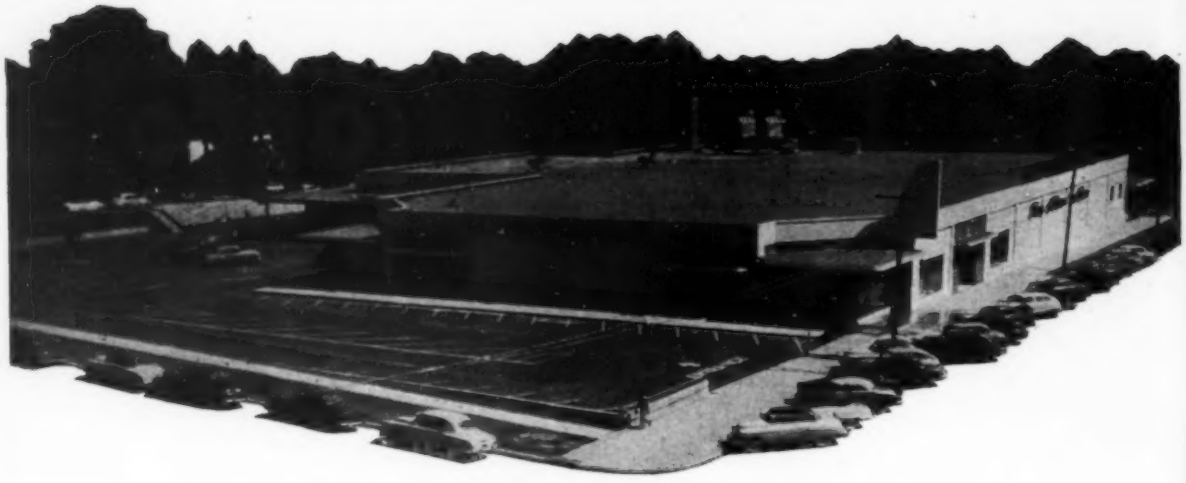

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VOLUME 21

NUMBER 8

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AUGUST, 1951

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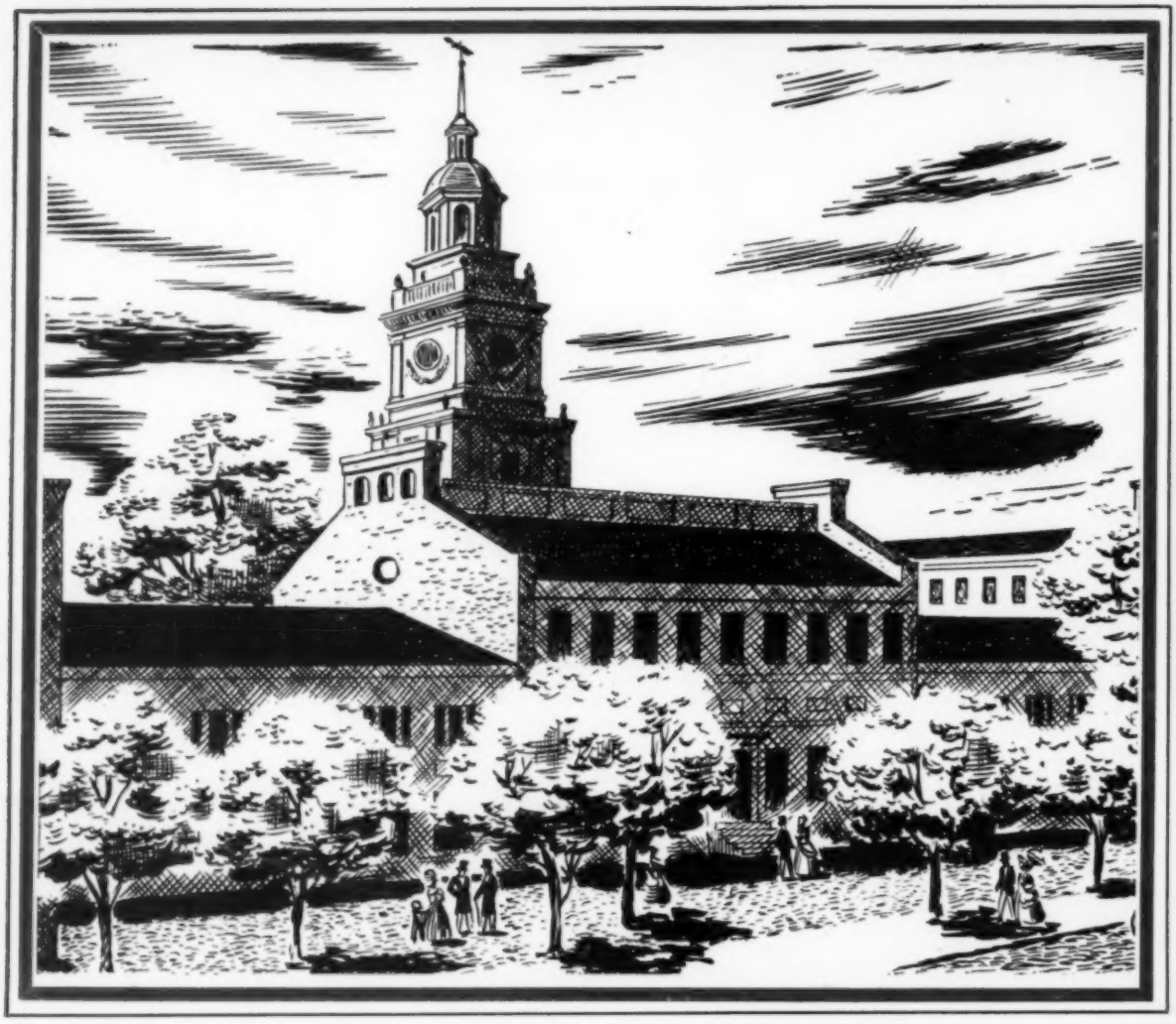

Philadelphia's Independence Hall, where the Liberty Bell is housed, as it looked 100 years ago

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Toll highways—are they justified?

MILEAGE OF TOLL ROADS is growing continually. Now open to traffic is this Catskill-Saugerties section of New York State Thruway, to be integral part of state's 535-mile toll route.

THAT the United States is in trouble about its highway system was brought out at a round table discussion sponsored by ASCE's Engineering Economics Division, presided over by Louis Mitchell, M. ASCE, and held during the Louisville Convention. Our nation is far behind in its highway building program. Automobiles and trucks turned out last year could not even be parked bumper to bumper on the meager mileage of new highways built during that year.

Financing is the real obstacle to the needed rapid improvement in our national highway system. We have the engineering experience and talent; we have the equipment; we have the construction know-how. Gasoline-tax revenue—a major source of funds for highway construction—falls far short of being adequate to maintain existing highways and at the same time finance badly needed new construction. Nothing short of a fantastic increase in the already unpopular gasoline tax could build all the "free" highways needed now.

Encouraged by the profitable experience with Pennsylvania Turnpike's truck and passenger traffic and the public acceptance of the payment of tolls for the use of this toll road, 18 states have enacted toll-road legislation. Already 600 miles of state-owned, self-liquidating turnpikes have been or are being built in seven states, and an additional 1,300 miles of route are reported under serious consideration. Modern dualized highways in special important locations cost up to $2,000,000 per mile or more. Bonds, when backed by the toll revenue from such superhighways and by the credit of the state, prove very attractive to bankers, insurance companies, and other lending agencies at low interest rates. Opinions of panel speakers, whose comments follow, appear to be unanimously in favor of toll highways. While the construction of turnpikes is not the complete answer to our highway troubles, engineers, legislators, bankers and the public agree that toll financing is a practicable method of building in a short time a considerable mileage of sorely needed traffic arteries.

Turnpikes are economically justified

ENOCH R. NEEDLES, M. ASCE

Howard, Needles, Tammen & Bergendoff, Consulting Engineers, New York, N.Y., and Kansas City, Mo.

WE ARE in trouble with our highways, which are so vital to our nation and its economy. Since World War II we have developed a motorized economy such as no one ever dared to predict. And our highway construction has not kept pace. In 1949 we built 5 million new motor vehicles and 20,000 miles of new highways. Stretched out bumper to bumper, 5 million vehicles reach just about 20,000 miles. In 1950 we built 8 million new motor vehicles and 20,700 miles of new highways, not enough new highways even to provide parking space for the new vehicles. All our older highways and our city streets are going to pieces, suffering from deterioration and obsolescence.

We have about one motor vehicle for every three of our population. As our population has mounted to 150 million, we have seen 30 million motor-vehicle registrations at the end of World War II mount to almost 50 million at the present time, less than six years later. We have in our nation about two-thirds of all the motor vehicles in the world. We have an industrialized nation with greater productivity than ever before, with nothing elsewhere in the world to compare with it, and our statisticians tell us that industry moves three times as much freight by truck as by rail. And our motor vehicles move mainly on highways that are better suited to the days of the Model T, and in many, many cases, to the days of the horse and buggy.

Consider the cost of the modern highway. Not much over ten years ago we could build what was then a modern highway for $50,000 per mile. Traffic densities and motor vehicles today demand something much better. The modern passenger car has speed, power, and safety built into it to a higher degree than ever before. The modern truck, so essential to our industry, has power and carrying capacity, and is with us in numbers never approached before. The modern highway must be designed for the modern vehicle. It must have flat curves, flat grades, long sight distances, durable pavements on frost-free and firm foundations, all possible safety features, and no grade crossings. In many cases, dualized highways are demanded. What is the cost of such modern highways? Experience has shown that under present conditions they cost $300,000, $500,000, $1,000,000 and up to $2,000,000 per mile—even more in some cases. Compare that with the $50,000-per-mile highway of only ten years ago.

We owe our deepest appreciation to those engineers in highway research, in the state highway departments and in the federal Bureau of Public Roads who have done so much to prepare us for the design of the modern highway. Their work and studies during the past twenty years have made us ready to meet the demands of today. The present inadequate national highway system cannot be blamed on the engineers. We

have the methods, designs, equipment and materials to produce the modern highway, and we have the engineers, contractors and manufacturers to do the job. All we need is the money with which to operate.

The modern toll highway is just another development of the amazing postwar era. (Table I gives mileages in 12 states.) If there are engineers who still argue that toll highways should not be built, but that all highways should be "free," their argument is with the public and not with me. The general public and their duly elected public officials are responsible for the toll roads in existence and under construction today. Personally, I believe the public decided wisely when it decided to build the modern toll highway. As an engineer it is my obligation and pleasure to help design and build the toll highways which the public considers essential, and which are unattainable in any other way. The public does not build a modern toll highway except to provide a modern traffic artery which is needed beyond question and which can be financed by no other means. The toll highway comes only as a necessity. From a practical standpoint it could not be attained in any other way.

Turnpike Era Began in 1940

Completion of the Pennsylvania Turnpike about ten years ago, marked the beginning of the modern toll highway. However it has been something of a made-work project, and consequently was not wholly typical of the toll highways which have come since World War II. The Pennsylvania Turnpike was revolutionary in many ways. It demonstrated how a new dualized traffic artery could be designed and built as a unit in a relatively short period of time if adequate funds were provided. It gave the public a wonderful demonstration of what is gained by building a major artery as an integrated project, with the completed creation made available to them to solve at one stroke the major problem of getting across the Alleghany Mountains. Our state highway departments have been cursed for many, many years with the necessity of building major highways on a piecemeal basis, over a period of many years, simply because of inadequate funds or political domination in the allocation of highway funds.

Another major point demonstrated by the Pennsylvania Turnpike was the attitude of the public toward the payment of tolls over a highway. The old privately owned toll highways of Colonial days are long since gone and practically forgotten. The reaction of the public to the payment of tolls in Pennsylvania was good. Drivers realized they were getting a special service for a special fee, a service which could not have been attained otherwise. The public does not seem to mind paying a specific tax for a specific result which they can see and feel. The Pennsylvania Turnpike toll or tax gave a direct return to the payer, the highway user.

From the Pennsylvania Turnpike and its records of traffic and revenue, we have learned to estimate more exactly the prospective use of a new traffic artery, and the conditions under which the public can be expected to patronize it. Engineers can now analyze prospective traffic and revenue for a toll highway with great assurance of accuracy, and that assurance grows as each new turnpike demonstrates its feasibility through performance.

Maine Turnpike a Financial Success

The first toll highway to be built after World War II was the Maine Turnpike between Portland and Kittery, Me. This was a notable development for two reasons. First, it was the first toll highway to be financed and constructed on a wholly self-supporting basis, without state, federal, or other form of subsidy. After $3\frac{1}{2}$ years of operation, the earnings are substantially in excess of estimates, and the public approval of this needed traffic artery is wide spoken.

Second, the Maine Turnpike is notable in that it parallels an existing major traffic route, U. S. Highway No. 1, throughout its entire length, being located only a mile or so distant from it. On the old route the safety

VIEWS OF completed Maine Turnpike illustrate, on facing page, restaurant and service concessions, J-type interchange, and separated roadways on bridge over York River. Grade separation structure, on this page, lower left, is also on Maine Turnpike. Other two photos on this page are of New Jersey Turnpike: three-level structure at Garden State Parkway (upper left), and Hackensack River Bridge under construction (below).

record was bad particularly during the summer months, because of the curves and density of travel, and the congestion could not be relieved without spending far more money than the state could possibly justify on this one highway and at the expense of the rest of the highways in the state. But there had been no previous demonstration of the extent to which traffic from U. S. No. 1 would pay toll to travel on a parallel highway, even though greatly superior in accommodations. The result has been most gratifying, since records show that about 80 percent of the through travel now pays toll over the new turnpike, regardless of the season of the year. The old highway, U. S. No. 1, is now being fully used as a local highway, serving all the towns along it to best advantage, and with a greatly improved safety record.

In the past three years there have been many startling toll developments in other states. New Hampshire has completed a successful turnpike from Portsmouth south to the Massachusetts state line, connecting with the Maine Turnpike on the north. The Pennsylvania Turnpike has been extended on a wholly self-supporting basis from Carlisle eastward to King of Prussia; near Philadelphia, and a westward extension to the Ohio state line is under construction.

The New Jersey Turnpike is under construction at a cost of approximately $250,000,000, connecting the George Washington Bridge on the north with the Delaware Memorial Bridge on the south. Legislation has been enacted to connect this turnpike at Bordentown with the Pennsylvania Turnpike at King of Prussia.

The Colorado Turnpike between Denver and Boulder is under construction, as is also the Oklahoma Turnpike between Tulsa and Oklahoma City. Preliminary studies are being completed for a turnpike across Ohio; the feasibility of a West Virginia Turnpike has now been established; and construction on both these toll roads should be under way in the next few months. Legislation has been enacted for a turnpike in Indiana and it is understood that preliminary studies are about to begin. The great New York Thruway is in part under study and in part under construction. Users will probably pay on an annual basis evidenced by a plate attached to the car, an unconventional method of collecting revenue.

As to the economic justification of toll highways, there are two aspects. One is the determination of feasibility for each individual project. The economic studies to determine feasibility require that the cost of the project shall be supported by the traffic and earning power of the project. No turnpike can be financed unless its economic feasibility has been established by qualified engineers acceptable to the financial interests who are to provide the construction funds. The tests for feasibility are severe, but the proven results to date are unusually satisfactory. What ordinary "free" highway must stand a similar rigid test as to economic feasibility before it can be built? How often do politics govern the spending of state highway funds without regard to economic feasibility?

The other aspect of the economic justification of toll highways is in respect to their impact on the national transportation picture. Our nation is so far behind in its highway building—and there is so little likelihood of any major improvement in the situation within the forseeable future—that any arrangement by which the public can finance new highways, particularly arterial routes, appears to be wholly justified. A greatly improved highway system is vital to our industrial productivity, the transport of freight, the conduct of general business, and the normal procedures of this highly motorized nation. The economic losses due to our present inadequate system are beyond estimate. Clearly the public knows what it is doing when it authorizes new toll traffic arteries to strengthen and supplement the national highway system.

The toll highway should be considered as a supplement to the free highway, to be built only when the demand is great and urgent, when necessity is obvious, and when construction is not otherwise possible. The public certainly always will favor "free" highways over toll highways, as will I, whenever and however they can be attained. The toll highway is a device of the modern era, and the public has a sound basis for supporting such construction under existing conditions. An informed public must always be the judge. As engineers, we may properly continue to design and build those projects which the public decides are needed the most.

TABLE I. PUBLICLY OWNED TOLL ROADS IN THE UNITED STATES
In Miles, 1950

State	In Operation	Under Construction	Currently Proposed (Additional)
Colorado	...	17	...
Connecticut	66	...	...
Indiana	...	...	145
Maine	44	...	...
New Hampshire	14	...	...
New Jersey	...	118	...
New York	40	64	498
Ohio	...	...	239
Oklahoma	...	88	...
Pennsylvania	260	67	234
Virginia-No. Carolina	...	...	170
West Virginia	...	...	118
Totals	424	354	1,404

MACADAM STONE is laid on New Jersey Turnpike north of Haddonfield-Berlin Road

Pennsylvania Turnpike set financial pattern

FARLEY GANNETT, M. ASCE

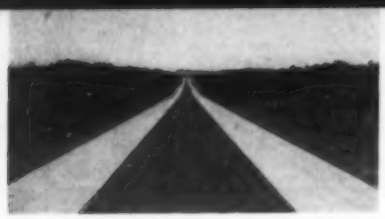
President, Gannett Fleming Corddry & Carpenter, Inc., Engineers, Harrisburg, Pa.

PENNSYLVANIA was the first state to have a toll road. This road was privately owned and built about 1750 to connect Philadelphia with Lancaster, 60 miles away. Two hundred years later, Pennsylvania was the first state to have a modern toll turnpike consisting initially of a 160-mile length, but soon extended to 330 miles to connect Philadelphia and the Ohio–Pennsylvania state line. Pennsylvania's first toll road may have cost as little as $200 or $300 per mile. Its most recent one cost $1,100,000 a mile—the Western Extension. That shows how the cost of toll roads has increased, although the toll per mile has decreased, owing to the vastly increased traffic.

The first toll route was a narrow, stone covered road for wagons and buggies. The most recent is a 4-lane, divided highway paved with concrete, for autos, trucks and busses. The speed on the first was perhaps 30 miles a day, as it took about two days to cover the 60-mile length—a distance which, on the present turnpike can be covered in about an hour.

In the early days there were about 2,000 miles of toll roads in Pennsylvania. We know little about the earnings of these roads but we do know that 200 years later some of them were still operating. Thus they must have made money to exist that long. Toll rates over some of the old roads were 2 cents a mile for a horse-drawn vehicle, and the prevailing rate

SECOND SECTION of Pennsylvania Turnpike to be built was Eastern Extension, which added 100 miles to original 160-mile route. Whole length, including Western Extension, will total 330 miles.



now is about 1 cent—one of the few items that is less now than formerly.

Our U. S. roads started as Indian trails which were usually fairly straight. Then came wheeled vehicles and roads which followed easier grades and were more winding. Now with the turnpikes, short straight roads have come again, with low grades built by cutting down hills, filling in hollows or constructing tunnels.

There are now about 3,000,000 miles of roads of all kinds in the United States, but barely 2,500 miles are modern, high-speed routes and only about 600 miles are toll roads, either completed or under construction. Over 1,300 miles more of modern toll roads are actively being planned.

The first large toll highway investment—the Pennsylvania Turnpike—was naturally a difficult thing in which to interest bankers. There had not been anything like it except toll bridges which involved a relatively small investment, and some of them had not done too well financially during the depression. It was only because excellent engineering reports of cost and probable traffic were available, and because the location was so perfect that the Pennsylvania Turnpike could be financed, and then only because the United States gave Pennsylvania $30,000,000 and the RFC purchased $47,000,000 of bonds to cover the rest of the cost.

Gross revenues in the first year were less than $3,000,000; they decreased to $1,500,000 during the gasoline shortage, but in 1950 they rose to nearly $9,000,000. It has been costing about a million and a quarter dollars a year to operate the 160-mile road, so the revenues are far more than ample to pay interest and amortize the cost. The bond interest, after two refundings, is down to about 2 percent on the original road bonds and doubtless the entire 330 miles will before long be on about the same basis. The great success of this venture has been the cause of the success of other toll-road financing.

Even if the entire cost of $77,000,000 were represented by 3-percent bonds, the interest would be only $2,310,000, which would be earned about three times over.

The voters in some states have turned down state bond issues for free road programs, and it is believed that they will do so in other states. Thus, in order to get roads built, some means of financing other than taxation must be employed.

It does not take a popular vote to create toll road authorities as it does to create a bond issue to be supported by state taxes. The State Legislature can, in most states, authorize a toll road authority and give it the necessary powers for raising funds, based on revenues only. The fact that so many state legislatures have authorized turnpike or toll road authorities is evidence that in future a great amount of progress in road financing and construction will be based on nothing but the revenues which the tolls will provide and will in no way involve state credit or aid from the federal government.

As they now operate, toll roads are freight roads as well as passenger roads. The passenger traffic over them is a secondary matter. Two-thirds of the revenue of the Pennsylvania Turnpike comes from trucks, and these vehicles would not use the route unless it paid them to do so.

Toll roads are paid for by the cars and trucks which use them, not by the taxpayers. No one who does not use these toll roads helps in any way to pay for their construction or upkeep. Also, out of-state users help pay for these roads. The states might apportion to toll roads a fair proportion of the gasoline-tax revenue originating on them. This would help finance these roads.

As more toll roads are built year by year, their design is changing and the New Jersey Turnpike, which is now under construction at a cost of over $2,000,000 per mile for its 120 miles, is being built to carry heavy loads. Every mile has been excavated at least 4 ft below the finished grade and refilled with selected porous materials, thoroughly compacted before the surfacing is placed. If the New Jersey Turnpike had to be built by ordinary methods of the State Highway Department, it would take 10 to 15 years on account of the amount of money to be raised and the amount of work to be done. Instead, the New Jersey Turnpike Authority has sold its bonds to large financial institutions, to be taken down as needed, and has employed eight firms of consulting engineers to report on location, estimate, design and supervise construction of the job, so that it is all being done in about two years.

One of the objections raised against toll roads is the high cost of collecting tolls, but in the case of the Pennsylvania Turnpike this cost is only about 3 percent of the total cost of operation, and this expense is largely offset by the revenues from concessions for gasoline, oil and food along the Turnpike right-of-way.

One difficulty that is being experienced with the Pennsylvania Turnpike, and will be with other turnpikes as they are built, is the traffic congestion that occurs at points of entrance and exit. Eventually, feeder routes will be built which may be either free or toll. Toll feeder lines are contemplated in Pennsylvania. A free 4-lane feeder road is being built from Route 40, which is a transcontinental road, to bring trucks as well as passenger cars from the south, at Washington, Pa., to the Turnpike just east of Pittsburgh. Similar feeder roads are talked of in New Jersey, Pennsylvania, and Ohio to be constructed after the main turnpikes are built.

READING, PA., INTERCHANGE of Eastern Extension, Pennsylvania Turnpike, is arranged so that one toll booth controls traffic in both directions. Toll collection on this turnpike costs only about 3 percent of total cost of operation.

New York State Thruway will pay its own way

J. B. McMORRAN, Assoc. M. ASCE

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ANY ROUND TABLE discussion of toll highways and their financing should include the situation in New York State. Here we have been wrestling with the problem for the past several years.

The urgent need for new highways and new methods of financing their construction is due to four nationwide factors:

1. The enforced neglect of road construction and reconstruction during 15 years of depression and war.
2. The spectacular increase in the production of passenger and commercial vehicles. For example, motor-vehicle registration increased 40 percent between 1940 and 1951.
3. The increased use of highways, especially by trucks. Between 1941 and 1948, miles of travel by passenger vehicles on main roads increased 11 percent, while miles operated by trucks increased 18 percent. During the same period, miles operated by truck combinations—especially heavy vehicles—increased 54 percent.
4. Failure of tax rates to return sufficient revenues for adequate highway programs. That this problem is general is evidenced by the fact that 32 states have given consideration to toll roads, and 18 have some sort of toll-road legislation now in effect.

In 1932 New York State spent 72 million pre-inflation dollars on its highways. Then came the depression; highway expenditures were curtailed; construction fell behind; and maintenance also failed to keep pace. Next came World War II, when both manpower and materials were unobtainable. By 1949, the median age of New York highways was 19 years and 46 percent of them were over 20 years old. During 1950 more than 3,880,000 vehicles were registered in New York State. January 1951 showed about 250,000 more registered vehicles than January 1950.

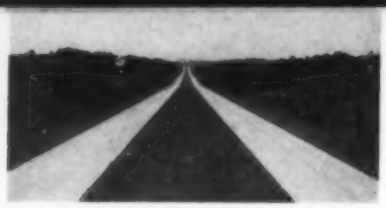
Faced with the hopeless problem of widening horse-and-buggy highways to accommodate a river of high-speed and heavy-laden traffic, New York, like nearly every other state, sought a solution in a new all-purpose expressway, known as the New York State Thruway. Originally it was determined that the Thruway would be a free road to be built with state appropriations, and several contracts have already been let on this basis. Soon, however, it was seen that this method of financing would take years to finish the job and would siphon away nearly all the funds from the rest of the highway system.

It was then determined to construct the Thruway as a self-liquidating venture. Various methods of collecting tolls for its use have been and still are under study. The experience of Pennsylvania, Connecticut, Maine and the Westchester County Parkways proves conclusively that motorists everywhere are willing and ready to pay a premium for the use of superior highways.

The arguments for toll financing of superior highways fall into four general categories:

1. Bond issues, secured by tolls, permit immediate construction of the facility, when it is needed most, and spread the payment over a period of years. Nearly every American homeowner experiences this when he borrows money on a mortgage for his home, so that he can live in it, enjoy it, and pay for it while he uses it.
2. The toll road is a charge on the direct user, in proportion to the benefits enjoyed, rather than on the general taxpayer. Only those who use

MALL BETWEEN LANES on New York State Thruway will vary in width from 20 to 150 ft or more. Section of mall is being graded here.



the superior highway pay for it, and then in proportion to the amount, or mileage, they drive on it.

3. Toll roads supplement free roads and, by their self-liquidating nature, release regular state highway funds for the modernization of free roads. Moreover, where a toll road has been built, much of the truck traffic is drawn off the free road, thus reducing wear on it and the immediate necessity for its reconstruction.

4. Revenues from concessions help defray the cost of operating needed public improvements. Gasoline stations, restaurants and snack bars are operated along every toll road. On the Pennsylvania Turnpike during 1949, revenue from such concessions totaled over $361,000. This revenue was more than the $224,000 cost of toll collections, and about 27 percent of the $1,334,000 spent on all operating costs.

Traditional methods of financing highways have proved totally inadequate to meet the demand for superhighways of the toll type. However toll revenues are not practical on many types of highways, and such highways should remain free. For high-speed, cross-state expressways which will not congest existing cities and villages, funds from annual budgets are too slow in becoming available and are completely inadequate to put such expressways into use now, when the need exists.

Tolls eliminate the necessity for fantastic increases in the gasoline tax—increases which are generally unpopular and difficult to impose. Originally gasoline taxes were imposed only for the construction and maintenance of highways, and it was with this tacit understanding that most state legislatures were able to pass gasoline tax laws. However, it soon became apparent that this was a painless method of collecting taxes for purposes other than highways. For this reason, while some states have anti-diversion laws forbidding the use of gasoline taxes except for highways, the public generally and the petroleum interests particularly, are opposed to any increase in gasoline taxes.

In New York State, the Thruway Authority has under consideration a special license plate which will permit vehicles bearing it to travel on the facility any time and any distance. The cost of this license plate has not yet been determined but for ordinary passenger vehicles it will probably be between $5.00 and $7.50 per annum. Truck plates will be higher, depending on size of vehicles and miles operated. These plates will be available at the same time and place as regular vehicle license plates. The out-of-state and occasional user will be permitted to pay a toll for the trip, based on its length. Policing and enforcement will be handled by the regular State Police.

At the November election, the people of New York State will be requested to permit the New York Thruway bonds to be backed by the faith and credit of the state. This plan has already been adopted in New Hampshire. It means simply that the Thruway bonds are guaranteed by the state; that is, should the tolls or license fees be insufficient to carry the bonds and the operating costs of the Thruway, then the State of New York would step in and carry it along. Use of the state's credit in this manner greatly reduces the cost of financing and the interest rate, and permits a greater amount of money to go into actual construction instead of into interest and debt service, so that the project can be put into use at a much earlier date.

Our experience in New York State shows the tremendous increase in highway use, especially by heavy trucks, and the willingness of all drivers to pay for a special facility, as evidenced on existing toll bridges and highways. These considerations make a project like the New York State Thruway economically justified as a toll road.

Photographs of the New York State Thruway in this symposium are used by courtesy of the New York State Thruway Authority.

BUILDERS of New York State Thruway must cope with all types of terrain, from swampland to hard rock, being drilled below. Separate contracts are let for grading, structures and paving. Views at right, from top to bottom, show grading equipment in action, steel reinforcing mesh being laid for paving, and finishing of pavement by hand.

Turnpike program must not hamper free-road net

BEN H. PETTY, M. ASCE

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BY ALL MEANS let's have turnpikes in those particular locations where they are justified by such factors as careful and thorough studies of traffic conditions, prospects that state highway construction will be unable to fulfill the need within a reasonable time, benefits to the economy of the area, and willingness of investors to assume the risk. The traffic is here, and it is way ahead of existing highway facilities in many localities. The annual increase in traffic outstrips the progress of highway improvement pretty generally in all states.

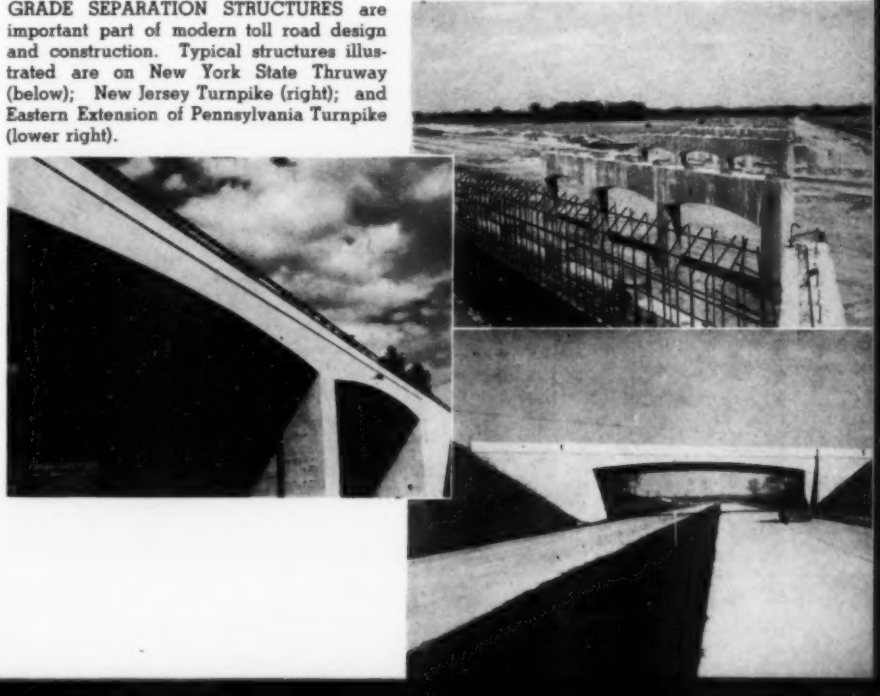
We desperately need vastly improved and enlarged highway facilities in several localities to relieve the terrific traffic congestion and hazards right now—not at some unpredictable future time as increased revenues and adequate, competent personnel may permit under normal procedures. Our national life is geared to a highway economy, and we cannot risk throttling this economy by continually building up highway deficiencies. No disparagement is meant to railroads, airways and other forms of vitally needed transportation, but it is safe to say that they all would be seriously crippled without highway service.

The turnpike method tends to eliminate similar state projects which pressure groups might force on a state highway department although they could not stand on their own feet financially. Banks, insurance companies and other lending agencies which back turnpike ventures are pretty sure of their ground before they agree to put up the scores of millions of dollars needed to carry such a project to completion.

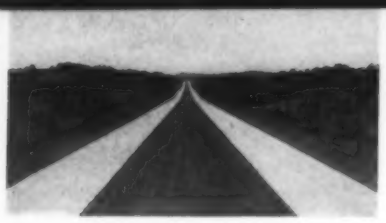
A likely economic effect of turnpike development, favorable to the highway industry as a whole, involves the possible beneficial influence of radical improvements in design and construction procedures on future highway construction in this country. These possibilities are of major importance in some states, and minor or zero in others where the state highway engineers are abreast of or ahead of the turnpike engineering.

The revenue-bond method of financing turnpikes, with the added feature of "forward commitment" as developed in New Jersey, provides one very satisfactory method of letting the actual users pay the bill. The "forward commitment" plan, under which reliable commitments are made for the total bond issue, but only a nominal stand-by fee of $\frac{1}{2}$ of 1 percent is paid on the still unused part of the total, is estimated to be saving some $10,000,000 on the total cost to the New Jersey Turnpike Authority. As such revenue bonds are issued by a public or semi-public agency, the returns on them are not taxable by the federal government.

The proposals for financing the 486-mile New York Thruway are attractive in that they eliminate the costly facilities and administration incidental to toll collections. It is proposed that frequent users of the Thruway be required to purchase a



GRADE SEPARATION STRUCTURES are important part of modern toll road design and construction. Typical structures illustrated are on New York State Thruway (below); New Jersey Turnpike (right); and Eastern Extension of Pennsylvania Turnpike (lower right).



special license plate. Infrequent users such as tourists would pay a much smaller charge for a temporary tag or certificate.

Objectionable Economic Features

While I agree with most that has been said by the previous writers in this symposium in favor of the toll method of paying the cost and maintenance of superhighways, I should like to point out that the method does have objectionable economic features which should be looked at carefully. This turnpike movement which already is well under way and spreading rapidly, should be so limited by actual needs and economic justification that the existing system and the orderly planning and construction of new, so-called, free highways will not be unduly hampered or jeopardized. The total prospective mileage of turnpikes is and always will be a minor part of our total primary road mileage. State and local highway needs everywhere must continue to be provided and maintained, and as little economic disarrangement as possible should be inserted into the picture by the turnpike program.

A recently published statement disclosed that the Tulsa-Oklahoma City turnpike, now under way, calls for only 40 grade separations whereas the route crosses 160 county roads. The cutting off of 120 of these local roads will certainly cause unfavorable economic reactions locally for at least a temporary period until proper adjustments in land-use and business can be made. Almost any major innovation causes losses to some and gains to others.

Since turnpikes are strictly a business proposition, points of access are limited by economic necessity. As a rule, traffic interchanges are omitted if their annual cost will be greater than the anticipated toll collections at that point. It has been reported that the cost of collecting tolls on the Pennsylvania Turnpike equals $3\frac{1}{2}$ percent of the intake.

What will the state highway departments inherit when all bonds have been paid off on a turnpike after 20 to 30 years of operation and it becomes the state's baby? Can all such highways, through toll collections, pay off all outstanding obligations, carry the operating costs, and keep maintenance up to a high standard within the economical life of the original pavement? Or will the state inherit a worn-out pavement requiring costly rehabilitation or complete reconstruction along with excessive maintenance costs on structures and other appurtenances which were built to higher standards than needed for state roads? And features such as some access points, for instance, may not fit in readily with the non-toll road system. Of course, the state highway department will get the right-of-way and grading free, but it might prefer to have these somewhere else at the time of inheritance.

There seems to be no sound reason why state highway departments could not be permitted by legislation to acquire funds by the revenue-bond process to build adequate free highway facilities where turnpikes are being promoted for the same purpose of handling traffic adequately. And I see no serious objection to the utilization of federal-aid funds to assist in the retirement of these bonds.

No Roads Are Really Free

Personally, I wish we could keep all our roads free. But the free-road idea is not sacrosanct. Why not free railroads, free airlines and free other forms of transportation? Actually, there are no really free roads. At least there are none in Indiana. Toll is collected for every mile of highway travel on our 84,000-mile total. There is no property tax for any roads in Indiana. The motorist pays the bill 100 percent, but the tolls are collected at the gasoline filling stations. The more miles we travel over roads each year, the greater is our annual highway toll bill. That is as it should be, but probably property taxes should be required to pay a reasonable share of the free highway costs, based on general community benefits. The general public is not and never should be taxed for turnpike construction and operation.

Whether we like it or not, toll roads are back again, and by the end of 1951 we will have over 500 miles in operation. The tide cannot be stemmed by simply saying, "I am against it." It is a highly debatable question, and pro and con arguments of real value should be thoroughly publicized now. Who knows for sure the right answer?

EASTERN EXTENSION of Pennsylvania Turnpike runs cross country for a hundred miles.

Nuclear shielding—a new engineering field

AN ENGINEER not directly involved in the atomic energy program may be confronted with a problem involving radiation shielding. This problem may be a phase of the handling, use or storage of radioisotopes used in medicine and biology and in industry and agriculture.

At the Oak Ridge Research Hospital, a 1,000-curie source of Cobalt 60 has recently been installed for the treatment of cancer. This very potent source will be surpassed by even greater source intensities in the years to come. Sources involving large radiation intensities necessitate very thick shielding, which in turn influences the planning and design of housing structures.

As the use of radioisotopes becomes more widespread, engineers must be prepared to take an active part in this phase of atomic energy. In the companion articles which follow, the authors present the new problem and the development of a solution to shielding from radioactive radiation by using walls of barytes (heavy) concrete.

What is nuclear shielding?

H. M. GLEN, Supervising Structural Engineer, Engineering Department, Oak Ridge National Laboratory, Oak Ridge, Tenn.

IN GENERAL, a mass of radioactive material may affect nearby persons in any of three ways: (1) radiation may penetrate the shielding in use; (2) radiation may be reflected (scattered) from surrounding objects to a receptor who is screened from the direct rays; (3) the primary source may induce activity in materials which are then transported into the receptor's vicinity.

The radiations with which we are concerned here are alpha and beta particles, gamma rays and neutrons. The mechanisms by which these radiations interact with living tissue are complex. By far the largest part of the physiological effect is produced by fast charged particles, since charged particles can most easily affect the material of which the tissue is composed. A charged particle passing through tissue upsets the balance of the atoms and molecules of the tissue by forcing the atoms to separate into positive or negative parts called ions. This destroys the delicate electrical balance of the molecules.

Only the alpha and beta particles interact directly with tissue. Other radiations achieve their effect by producing fast charged secondary particles in an intermediate step. Gamma rays produce Compton recoil electrons or photo-electrons, which then act like beta particles. Fast neutrons transfer their translational energy to hydrogen nuclei (protons), which then pass it on to the tissue. Thermal neutrons have no effect on tissue until they are captured, usually by hydrogen, with the emission of a 2-mev (million electron volts) gamma ray. The quantitative description of the physiological potency of radiation is by no means as clear cut as might be desired. The Roentgen (r) being the measure of X-ray and gamma radiation, it may be stated that one "r equivalent" of neutrons or betas produces the same physiological effect in tissue as one r of gamma.

An alpha particle (He^{++}) is a doubly charged positive helium nucleus. These particles have a velocity up to one-fifth of the speed of light. Since they are doubly charged and of relatively large mass, they are one of the most easily stopped of all types of radiation, being absorbed almost immediately by any form of matter. Alpha particles are no health hazard unless an alpha emitter is introduced either into the stomach by ingestion or into the lungs by

WALL IN FRONT OF operator is concrete barricade behind which radioisotopes produced at Oak Ridge National Laboratory are stored. In rear of room, at operator's left, two viewing windows filled with zinc bromide solution and lead door may be seen in wall of lead and structural steel.

LEAD DOOR is opened in barricade wall of lead and structural steel.

OPERATOR REACHES through door in Lucite front of beta hood.

breathing. Extensive damage by ionization is then caused. Alpha emitters are radium, radon, uranium and other naturally occurring radioactive substances. Very few artificially produced radioactive isotopes are alpha emitters. An exception is the case of alpha particles used in a cyclotron or other type of particle accelerator. In these cases energies up to 500 mev may be encountered, in which event suitable shielding must be provided.

A beta particle (-1^{e^-}) is an electron or positron originating in the nucleus. These particles are singly charged and have energies from about 14 kev (thousand electron volts) for Hydrogen 3 to about 13 mev (million electron volts) for Lithium 7. Most fission products and isotopes produced by neutron bombardment are beta emitters. Although high-energy beta particles can penetrate the human skin, an aluminum shield 3 mm in thickness will stop a beta particle of 2-mev energy. The health hazard from beta particles is similar to that from alpha particles, except that as the beta particles are singly charged the ionization damage caused is less than that caused by alpha.

Gamma rays are electromagnetic photons identical in properties with X-rays. They have the velocity of light regardless of their energies. They possess no electric charge and are therefore classed as non-ionizing radiation. Gammas are very penetrating and since their wave lengths are shorter than X-rays, their damage to body cells is proportionately greater. Shielding design for gamma radiation is dependent on the particular wave length (energy) of the gamma emission, but in all cases a heavy material, such as lead, is the best gamma absorber.

Neutrons are uncharged particles of about the same weight as protons, and are roughly divided into three groups: (1) **thermal,** or slow neutrons which are in the energy range of 0.03 ev; (2) **fast neutrons,** which are given off in fission and have energies greater than about 0.5 mev; and (3) **intermediate or resonance neutrons,** which have energies between (1) and (2). It is to be understood that these energy values are approximate and there is considerable overlapping in the various types of neutrons.

Neutrons are very penetrating, but unlike gamma rays are not shielded by a heavy material; they are slowed down by collisions with the nuclei of matter. Fast neutrons are slowed down, or thermalized, by shields or moderators containing hydrogen such as water or paraffin. These thermal neutrons are in turn absorbed by materials such as boron or cadmium, which have high capture cross-sections and are widely used for control rods in reactors. However, boron has a distinct advantage over cadmium in absorbing thermal neutrons. This absorption of neutrons by boron results in the liberation of an alpha particle, which is very easily stopped. In the case of cadmium, this neutron capture is accompanied by the emission of gammas, which in turn must be shielded. Neutrons may be captured by the nuclei of various elements to form other isotopes of those elements. Design data for neutron radiation shielding is still confidential but since no radioisotopes are neutron emitters, this omission will not be missed.

Materials of Nuclear Shielding

For shielding against gamma radiation, the elements of high atomic weights are best. Lead is commonly used because of its availability and relatively low cost. For structural reasons, concrete and steel are often used. In order to increase its effectiveness as a shield, concrete is often modified by using barytes or steel pellets as aggregates. Viewing windows are usually filled with zinc bromide solution—a heavy liquid—which has the equivalent shielding properties of regular concrete. Access doors for personnel and equipment are normally made of lead in a steel frame, or of sheet steel with sheet lead affixed to one side. Frames for access doors and viewing windows in concrete barricades are sometimes filled with poured lead or lead shot to prevent radiation around the openings.

Cells, barricades and other forms of personnel shields are usually placed in single-story buildings. For normal source intensities, the top or ceiling side of these shields are omitted, but sources of 10 curies and up should never be placed in an open-top shield.

For intensities in the range up to 10 curies, it is often necessary to place auxiliary shields over the source to prevent gamma sky shine from the air, building ceiling, structural steel, and lights. A thin sheet of lead is often used for this purpose. If strong betas are present, this lead sheet should be faced with a thin sheet of Lucite to prevent the betas from forming gammas. If a thick lead shield is used, this Lucite shield may be omitted.

The intensity of a radioactive source is usually measured in terms of curies. One curie (c) was originally defined as the amount of source material giving the same number of disintegrations per second as one gram of radium. This unit has been experimentally measured and is now defined as 3.7×10^{10} disintegrations per sec. Since the curie is a rather large unit, often the millicurie (mc) is used. This millicurie is one-thousandth of a curie (0.001 c). The curie has no relation to the absolute amount of material present in the source. A small amount of material with a short half-life can be equivalent to a very large amount of material with a long half-life, as will be explained later.

The quantity of gamma radiation at any point is measured in terms of roentgens (r). One roentgen is that amount of gamma radiation which will produce one electrostatic unit of ions, of one sign, in 1 cubic centimeter of dry air under standard conditions of temperature and pressure. Since the roentgen is also a large unit, often the milliroentgen (mr) is used. This milliroentgen is one-thousandth of a roentgen (0.001 r). Note that the roentgen is a measure of the quantity of radiation but does not measure the intensity of radiation. For this reason intensities of radiation must be given in roentgens per unit of time as 1.0 r per hour.

The human body is said to tolerate indefinitely a weekly total body irradiation of 0.250 r of gamma, roentgen equivalents of neutrons or betas, or a combination of the two. The lifetime total is 300 r or "r equivalents." Acceptable design tolerances are 7.5 mr per hour or 50 mr (0.05 r) per day.

Since the object of most calculations is to find what conditions must be met in order to reduce exposure to the tolerable level, radiation intensities will be given in this article in terms of r, or r equivalents, per eight-hour day, which is 50 mr.

The activity of a radioactive material decreases continually with time. For a given quantity of radioactive material this activity might approach zero in less than a second or remain relatively unchanged for millions of years. This depends on the particular isotope under consideration.

The time required for a radioactive material to lose one-half of its activity is called its half-life. For example, take radioactive iodine (Iodine 131). This isotope has a half-life of eight days, which means that in this period of time a sample of I^{131} containing originally one curie (c) would decrease to an activity of 0.5 c. At the end of a second period of eight days this sample would have an activity of 0.25 c and so on.

Design Data for Alpha, Beta and Gamma Radiation Shielding

Shielding of most **alpha emitters,** it has been stated, presents no problem to the engineer. However, the machining, grinding or cutting of these alpha emitters should only be done under dust-free conditions. Since a fragment of an alpha emitter still remains radioactive, it is imperative to prevent this dust from entering the human body. Usually these ideal working conditions are obtained by the use of hoods and dry boxes which operate under negative pressure, and of vacuum dust removers which may be adjusted to pinpoint a particular operation.

The shielding of most **beta emitters** also presents no problems to the engineer. However, when high-energy beta particles are rapidly decelerated by a metallic shield, their sudden decrease in energy is accompanied by the emission of low-energy gammas. This is known as braking radiation.

In some cases artifically produced radioisotopes, as well as those occurring naturally, emit both beta particles and gamma rays. For these it is evident that sufficient shielding to satisfy the gamma radiation will be more than ample to stop the beta particles. In those cases where beta particles alone are emitted, a non-metallic shield such as Lucite would be used for storage and shipment.

Gamma rays (photons), from radioisotopes, practically all fall within the energy range of 0.07 to 3.0 mev (million electron volts). Within these limits the Compton's scattering effect (absorption process) is the most important factor in design calculations. In this process the photons behave as small particles and undergo billiard-ball-like collisions with the electrons. This causes a scattering of the photons but does not result in absorption of all energy of the original photon. These scattered photons are of longer wave lengths (lesser energy) and must be considered in most shielding problems.

All gamma radiation problems are divided into three phases: (1) determination of the radiation intensity, I_0, at the proposed location of the shield, (2) determination of the shielding itself, and (3) addition of a "build-up factor" to compensate for possible deviation from the exponential absorption law.

(This article comprises the introductory section of a paper on nuclear shielding which is to be presented by Mr. Glen before the Structural Division at the ASCE Annual Convention in New York, October 22–26. The complete paper will be available for publication by ASCE. It includes design data and charts which will enable engineers to cope with simple shielding problems.)

Barytes aggregates make heavy concrete for shielding

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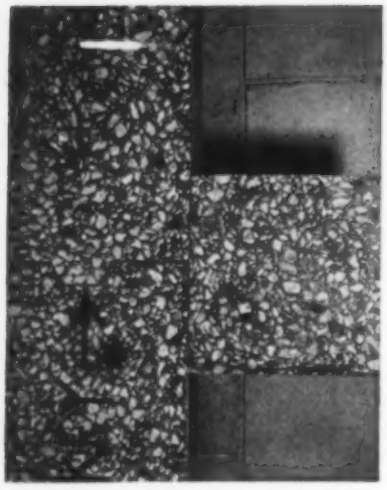
LONG BEFORE the first atom bomb was exploded, in fact ever since the beginning of large-scale experimentation with radioactive materials, concrete has been used extensively to protect man from overexposure to the various rays omitted by "hot" materials. The reasons for its use are economic as well as expedient. Cement, stone and sand are readily available almost anywhere. The cost of mixing and placing concrete is not excessive. It can be designed to function both as a structure and as a shield. Its economic value as a shield can best be appreciated by a comparison of the amounts of other materials required to provide an equal measure of protection, their adaptability, and relative costs.

For high-energy gamma radiation, the relative amount of various materials required is about in direct ratio to their densities, or weights. Thus if steel weighs 490 lb per cu ft and concrete 145, it follows that a sheet of steel 1 ft thick has a shielding value approximately equal to a concrete slab 3.4 ft thick; a 1-ft-thick slab of lead weighing 708 lb per cu ft would be equivalent to a 4.9-ft thickness of concrete.

What then are the determining factors in choosing the shielding material for a structure or building in which highly radioactive material is to be used? If space is limited and a given amount of floor space is required, any reduction in the thickness of the shielding wall becomes an important consideration. Then, assuming that 6 in. of lead are required for shielding, a 6-in. wall of lead would have a decided advantage over a



SECTIONS cut through test wall, weighing 220 lb per cu ft, show excellent quality of concrete. At left, arrow points to 20-hour cold keyed joint in vertical section, where concentration of large aggregate may be noted. Chalk mark, top locates 4-hour joint and shows perfect blending between pours.

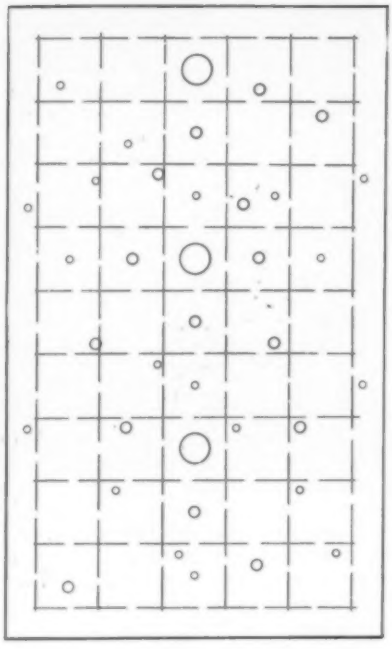


TABLE I. DESIRABLE MIX FOR HEAVY CONCRETE

In pounds per cubic yard

	Proportions Established by Experimentation	Quantities Actually Used in Test Wall	Quantities Specified for Cell Construction
Coarse	2,860	2,991	3,000
Fine	2,210	2,282	2,250
Cement	658	679	658
Water	317 (38 gal)	322	321 (38.5 gal)

FIG. 1. BROKEN LINES show position of vertical and horizontal reinforcing steel in three of five test panels—all 1 ft thick, 5 ft high, and 3 ft wide. Reinforcing was placed 1½ in. from each face. Circles indicate 37 lead-filled sleeve inserts which were included in same three test slabs to simulate pouring conditions in actual radiation shielding walls. Two of five test panels contained no reinforcing or sleeve inserts.

concrete wall 2.5 ft thick; but if the wall is high, say 15 or 20 ft, then the structural characteristics of lead would make its use highly impractical as well as costly. Lead is an excellent shielding material, but practical only within a limited range of requirements.

Steel might be called the antithesis of lead. While it is structurally strong, its lack of workability and adaptability limits its use to definite boundaries of design requirements, beyond which it too becomes impractical. Other materials have been found to have advantages, but in the final analysis the answer is the same—too costly.

The one disadvantage of concrete for heavy shielding is the great thickness required as compared to other denser materials. Structural strength, workability and adaptability, and low cost per unit of shielding are characteristics in its favor. Many experiments have been made by the Technical Division of the Oak Ridge National Laboratory to produce a modified type of concrete that would be heavier than normal and thus reduce the thickness required. Several types of metallic aggregates were tried, including nails, ball bearings, and steel punchings. Some mixes achieved a surprising density but this was offset by undesirable qualities, difficulty in handling, and excessive cost.

Coincident with the start of design of some new research buildings for the Laboratory, I was asked to investigate the possibility of using barytes (barium sulphate) as aggregates in heavy concrete, to determine if a satisfactory concrete having a shielding potential of 50 percent above ordinary concrete could be produced economically. Based on a weight of 145 lb per cu ft for ordinary concrete, we set as our goal a concrete of 217.5 lb per cu ft. A barytes quarry and crushing plant near Sweetwater, Tenn., approximately 30 miles from the Laboratory, was found which had considerable amounts of this material screened, graded and stockpiled.

Our job would have been simplified considerably if we had been concerned merely with filling a space between two forms with a heavier-than-usual concrete. Plywood forms 4 ft apart, suitably braced, with reinforcing steel and square or boxed plugs for any openings in the wall, would about describe a normal form ready for concrete. But for cell walls this is just the beginning. Steel sleeves 4 to 6 in. in diameter, on 24- or even 18-in. centers horizontally and vertically, must be installed to receive removable lead plus containing process piping. In between are innumerable smaller sleeves for conduits and wiring. Here and there openings are provided for the manipulation of mechanisms by remote control. Ventilation ducts, periscopes, shielding windows, and staggered-edge doors are some of the other items for which provision must be made. In addition, anchors for wall inserts are usually placed in large numbers on the inside face of the wall. The result is a form literally stuffed with obstructions.

The second requirement our heavy concrete had to meet was that, after falling over, between, and around all the obstructions in the forms it should recombine into a homogeneous mass with even distribution of aggregates. This is necessary to maintain uniform shielding quality, and this we could not get if pronounced segregation of aggregates occurred. Our concern as to what structural strengths concrete made with this aggregate would develop, considering its soft friable appearance, was short lived as compression tests all showed satisfactory results not too dissimilar from those with ordinary concrete of like proportions. Several independent tests made by the Skidmore, Owings & Merrill Co. at their testing laboratory, showed strengths, for a 1:3.8:5.1 mix, of over 3,000 psi at 7 days, and 3,800 psi at 28 days.

Three trial batches made to the proportions recommended showed that the large aggregates had a definite tendency to separate from the mass in the mixer. When rodded in the form they also showed undesirable voids and a coarse appearance. In one of the three batches an air-entrainment dispersion agent was introduced but it had no noticeable effect. Because additional mixes of

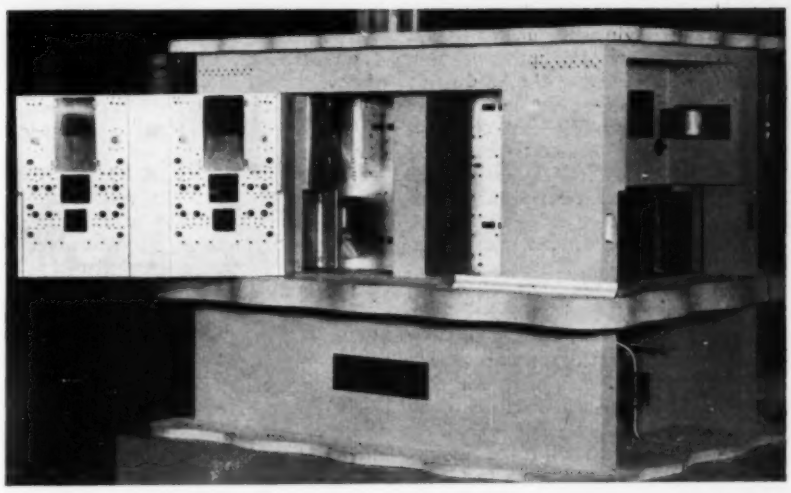
TABLE II. SIEVE ANALYSIS OF SPECIFIED BARYTES AGGREGATES

As reported by Skidmore, Owings & Merrill Co.

Coarse		Fine	
Sieve size	Percentage passing	Sieve size	Percentage passing
1 1/2 in.	100	3/8 in.	100
1 in.	93	No. 4	96.4
3/4 in.	67	No. 8	77.6
1/2 in.	29.5	No. 16	51.6
3/8 in.	16	No. 30	28.6
No. 4	4	No. 50	13.0
No. 8	1.7	No. 100	4.4
		No. 200	0.4

Weight per cu ft, 159 lb dry rodded
Spec. gravity, 4.287
Voids, 37.3 percent

Unit weight, 163.0 lb per cu ft dry rodded
Colorimetric, Plate No. 1
Spec. gravity, 4.04
Absorption, 1.4 percent
Voids, 38.8 percent
Mortar strength, 7 days, 162.5 percent of Ottawa
NOTE. All fines retained on No. 7 sieve (8 wires to the inch) were discarded for test wall.



MODEL of bank of cells under construction in Isotope Research Building, ORNL, is to scale of 1 in. = 1 ft. Engineer's scale lies on main floor of model. Upper section, 17 ft high, of barytes concrete construction, contains four cells with walls 3 ft thick. Section of model wall is swung back to show intricate arrangement of openings, setbacks, and inserted fixtures, such as periscopes, dense-liquid viewing windows, steel sleeves for remote-control operations, conduits and lead doors. Below main floor, ordinary concrete walls 2 ft thick house ventilation ducts, process piping and conduits.

various proportions, to which an air-entrainment dispersion agent was added, likewise showed no apparent difference from the same mixes without it, no further consideration was given to air entrainment.

We then experimented further by mixing unmeasured amounts of the various materials taken from predetermined quantities of each, until we had what seemed like a desirable mix. The remaining quantities of each ingredient were then weighed to determine how much of each was contained in the trial mix. This procedure was repeated twice more, and all three mixes were surprisingly similar. The slump tests of these mixes varied from 2 3/4 to 3 1/4 in.

Satisfied that we now had the necessary data for establishing a mix that would probably meet all the requirements, we set up Table I. It shows the proportions established for a 1-cu yd mix based on the experimental mixes described above, and incorporates the gradation reports on the aggregates as determined by the Skidmore, Owings and Merrill Laboratory and shown in Table II. For comparative purposes, the amounts of each ingredient actually used per cubic yard are shown in the second column of Table I.

Test Wall Poured

As the final stage in the experiment, a test wall was poured, and when the concrete was sufficiently cured, its shielding qualities were tested by exposing it to radioactive source materials and measuring the radiation transmitted through it.

This wall was 15 ft long, 5 ft high and 1 ft thick. It was separated into five sections, each 5 ft high, 3 ft long and 1 ft thick, with 3/4-in. plywood between sections. To simulate the exact conditions that might be encountered in pouring actual cell walls, the forms for slabs Nos. 1, 2 and 3 contained horizontal and vertical reinforcing bars on 6-in. centers, 1 1/2 in. from each face. In addition, each of these three slabs contained 37 lead-filled pipe sleeves ranging in size from 3/4 to 3 1/4 in. The arrangement of steel and sleeves is shown in Fig. 1. The forms for test slabs Nos. 4 and 5 were left empty.

The reasons for this arrangement were

1. To determine by means of the shielding test whether any irregularities in the disposition of the aggregates or any voids under or around the sleeves would be detectable in the slabs containing the steel and sleeves, and at the cold joints in slabs Nos. 4 and 5.

2. To determine what effect, if any, different methods of vibrating would have on the shielding qualities of the concrete. For this reason the concrete in each of these slabs was to be treated differently. Slab No. 1 was to be vibrated only from the outside by placing a mechanical vibrator against the outside of the forms. Slab No. 2 was to be vibrated from the inside only (if steel and sleeves did not prevent getting the vibrator far enough down in the form). We wished to determine the effectiveness of this method of vibrating under these conditions where obstructions made the insertion of a vibrator difficult. Slab No. 3 was to be rodded by hand. Slab No. 4 was to be filled in three pours. The first pour was to be vibrated and then permitted to stand for approximately 18 hours; the second pour was to be vibrated and allowed to stand for 4 hours; and the third pour was to fill the form and be vibrated only lightly. Slab No. 5 was to be filled in exactly the same manner as Slab No. 4 except that a 2×4-in. key was to be placed in the 18-hour joint. The purpose of pouring Nos. 4 and 5 in this manner was to determine if the cold joints would permit any increased radiation to pass through.

As a further check on the disposition of the aggregates, two slabs were to be cut longitudinally through points where any pronounced variation in radiation penetration might occur, to permit visual examination of the concrete at those places. A mixer of 1/2-cu yd capacity was used, but because of the weight of the aggregates, batches were mixed that contained approximately 1/3 cu yd. All ingredients were measured by weight; the mixing time was 2 min; wheelbarrows were used to move the

concrete from mixer to forms; and the average moving distance was 48 ft.

Two cylinders taken from this concrete were tested in the Skidmore, Owings & Merrill testing laboratory. One developed a compressive strength of 4,987 psi at 11 days; the other 5,906 psi at 28 days.

Slab No. 1 was poured first and vibrated from the outside only. The concrete seemed to perform satisfactorily in passing the obstructions in the forms. This slab, however, showed about $^3/_8$ to $^1/_2$-in. shrinkage during (and probably caused by) the pouring and vibrating of slab No. 2. After forms were stripped, this slab showed the smoothest surface of all the slabs.

Slab No. 2 was vibrated inside. Vibrating was done successfully despite difficulties. No shrinkage was detected after vibrating. After the forms were stripped, the surfaces were almost, but not quite, as smooth as those of slab No. 1.

Slab No. 3 was hand rodded with a $^3/_4$-in. bar having a rounded point, a slow and difficult operation, and not to be recommended. It showed about a $^1/_8$-in. shrinkage after rodding was completed. After stripping, the surfaces were slightly rougher than those of slab No. 2 but showed no pockets or honeycombing under the pipe sleeves.

Slab No. 4 was filled in three pours. There was no evidence of the 4-hour joint on the surface, which had a good smooth appearance except where the second pour seeped considerably, running down between the form and the first pour from the 20-hour joint. This seemed to indicate a spreading of the forms when the second pour was made. This conclusion was confirmed later when the slabs were cut, and will be discussed later. The third, or top pour, which was only lightly vibrated, showed more air holes on the surfaces than any other.

Slab No. 5, made like No. 4 except for the key, was similar in appearance to No. 4.

Examination of all slabs showed all the corners to be sharp and trim, and the appearance of the surfaces satisfactory beyond our expectations.

After the forms were stripped, the wall, with the exception of slab No. 5, was kept wet and covered with a tarpaulin for 48 hours, then slabs Nos. 1, 2, 3 and 4 were covered with wet burlap under the tarpaulin for 6 more days. Slab No. 5 was left exposed to the weather. No difference in appearance was discernible between slab No. 5 and the rest of the wall after the wet burlap was removed. This result should perhaps not be considered too significant as the weather during the period of curing was cool and cloudy with high humidity and much fog.

The shielding tests were conducted by T. H. J. Burnett, of the Health Physics Division, Oak Ridge National Laboratory. By way of preparation for these tests, each slab was identified by number and was marked off by chalk lines into fifteen 1-ft squares on both sides. Each square was given a letter, the same on both sides of the slab, for identification from either side. Three different tests were made.

In the first test a 22.28-mg radium source and a Victoreen 263 survey meter were used. In this test the source was contained in the end of one leg of a U-shaped yoke which fitted over the wall. By this method, since both legs of the yoke were of equal length, the position of the source was always obvious to the recorder, who of course was on the side of the wall opposite to the source.

The second test utilized a Cobalt 60 source having a strength of approximately 9 curies. This source was suspended against the face of the wall and manipulated by a cord. Its position was controlled by the use of mirrors. A "cutie pie" meter was used to record the radiation penetration in this test. For comparative purposes, this source was also used to make a similar test of a 12-in. wall of ordinary-type concrete.

The third test was made with a 27.03-mg radium source, which was attached to the wall with scotch tape, and the readings were made with a Lauritsen electroscope. Comparative readings were also made of ordinary concrete walls 9 and 12 in. thick.

All tests showed a satisfactory uniformity of density throughout all the slabs. No evidence of any pronounced segregation, voids or lack of homogeneity was found. Variations in the readings were not significant, and were well within reasonable limits. One point on slab No. 5, square B, showed a reading of 1,000 mr per hr (although average range of readings was from 700 to 900) but this probably was caused by the fact that the reading was taken near the top of the wall, where the recording instrument was exposed to shine or scatter. However, the spot was marked and the slab was later cut longitudinally through this point, but no evidence of any voids, segregation or other flaws was evident.

From these tests Mr. Burnett concludes that, for high-intensity gamma radiation, the shielding qualities of this type of concrete as compared to standard concrete is in proportion to its density. He assumed a weight of 225 lb per cu ft.

Conclusions from Tests

In view of these test results, the following conclusions may be drawn:

1. Barytes can be used successfully to produce a heavy concrete—220 lb per cu ft—for cell construction and for shielding purposes, provided it is not to be submerged in water or exposed to continuous heavy washing action.

2. Barytes concrete can be produced economically. The difference in cost between it and standard concrete per unit of shielding is the difference in price of the respective aggregates. Extra care should be given to bracing and tying the forms to maintain dimensional accuracy, especially in high pours when the forms are free of obstructions.

3. To obtain uniform density, maintain homogeneity, eliminate voids and coarseness, and retain a high degree of plasticity and workability, the following specifications are recommended:

Recommended Specifications for Heavy Concrete

Aggregates. Barytes, as stockpiled at crusher near Sweetwater, Tenn.

Coarse aggregate.
Passing 1½-in. screen 100 percent
Retained on No. 4 screen . . . . . 97 percent

Fine aggregate . All passing No. 7 screen (8 wires to the inch)

Mix for cell construction.

Large . . .	3,000 lb
Fines	2,250 lb
Cement . .	658 lb (7 bags)
Water . . .	321 lb (38.5 gal)

Aggregates should be weighed.

Water content should be maintained and controlled by slump tests.

Slump should be 3 in. for ideal mix, and should not be less than 2⅝ in. nor more than 3½ in.

Minimum mixing time should be 2 min.

Concrete should be carefully but thoroughly vibrated with a mechanical vibrator, after which the vibrator should be applied lightly over the outside of the form.

Curing should follow standard methods for ordinary concrete.

To avoid spreading of the forms at cold joints, care should be exercised to adequately brace the forms at the top of any pour which is permitted to develop any degree of set before additional concrete is placed above it.

Survey of salaries for civil engineering positions

Spring 1951

EMPLOYMENT CONDITIONS vary widely among organizations. There are somewhat different patterns of employment conditions between public agencies and private firms or corporations, but the widest differences probably depend more on the formality or informality of organization and administration. All previous reports of the ASCE Committee on Salaries have been in terms of payroll rates only and have not included consideration of factors related to employment conditions, the more advantageous of which are sometimes referred to as "fringe benefits."

Some benefit factors are tangible and their values can be computed in dollars of equivalent salary. Other factors are intangible and do not lend themselves readily to such specific evaluation. Yet management, in establishing pay schedules, gives consideration to these tangible and intangible conditions of employment as well as to the payroll rates. Similarly an employee, in attempting to evaluate the advantages and disadvantages of his own personal situation in the organization, and especially in comparing it with a possible position with another organization, will try to balance all the factors, tangible and intangible, that seem significant to him in order to arrive at an estimated over-all value for each position.

Since the evaluation of intangibles is highly personalized, it is not practicable to try to evaluate such items in a salary survey. Tangible factors, however, can be evaluated in dollars and added to the payroll rate to produce a sum which can be designated "total equivalent compensation," and that is the method followed in this study.

This report has been prepared from data on civil engineering positions furnished during February, March, and April 1951 by 120 engineering organizations widely distributed over the continental United States, representative of the principal types of organizations that employ civil engineers, and large enough to have positions that can be allocated to a considerable number of the grade levels in the ASCE classification plan reproduced herewith.

As the result of certain investigations, the Committee believes that some of the maximum and minimum entrance rates shown in the columns headed "Total Range," in Tables I, II, III, and IV, apply to positions which were not properly classified by the respondents to the questionnaire. Except for these extreme values, however, a study of the reports indicates that the allocations to grade appear to have been consistently and satisfactorily performed, and the Committee believes that the medians and middle 50 percent ranges are reliable as of the dates shown.

Organizations furnishing data and the number of their engineering employees were as follows:

	Data Requested	Data Furnished — No. of Orgns	Data Furnished — No. of Engrg Employees
Consulting engineers	68	40	1,886
Construction firms	57	19	2,194
Railroads	9	6	1,071
Public utilities	6	2	292
Industries	8	3	83
Total private organizations	148	70	5,526
State highway departments	23	22	14,927
Municipalities	32	21	1,935
Counties	6	5	711
A regional organization	1	1	21
A large federal authority	1	1	451
Total public organizations	63	50	18,045
Total organizations	211	120	23,571

It should be noted immediately that the rates shown in Tables I and II and in Fig. 1 are not payroll rates. They are the statistical results of a survey and represent median total equivalent compensation at entrance to the grades shown, receivable by engineering employees performing professional work (as distinct

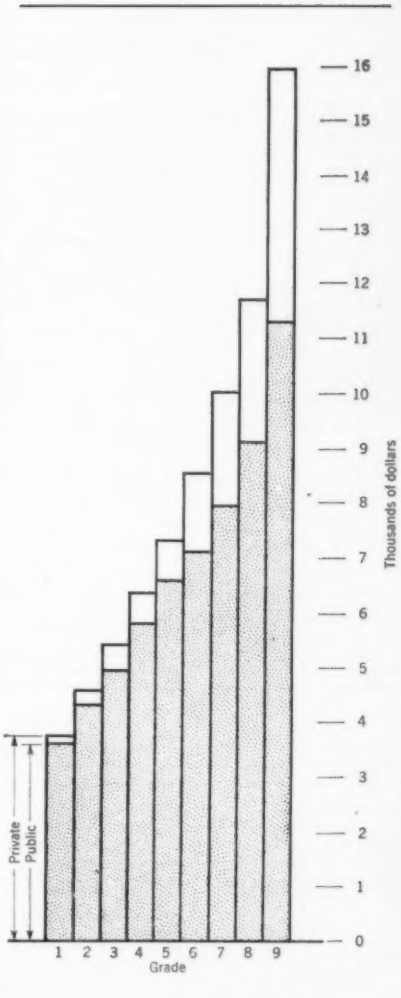


FIG. 1. MEDIAN TOTAL equivalent compensation at entrance to grade shown. This compensation is sum of payroll rate plus value of certain tangible perquisites. Data obtained from ASCE survey of February, March, and April 1951.

from the usual concept of subprofessional work) in the continental United States.

The rates shown in Tables III and IV, however, are payroll rates (adjusted to a 40-hour week) and are furnished for comparison with previous ASCE reports which did not consider the dollar value of perquisites.

In studying the statistical results, it should be remembered that when there is careful selection of highest-quality men, such men immediately command higher salaries than under less exacting specifications.

The tabulated rates should not be considered as absolute. Neither are they recommendations. The results of the survey are published as information and for guidance in the study of compensation for civil engineering positions. If more precise data on prevailing rates are desired, they can be obtained by performing a salary survey in a particular region or area. An ASCE Manual on Job Evaluation and Salary Surveys, to be published in the fall of 1951, describes the method of conducting and evaluating such surveys.

ASCE Classification of Civil Engineering Positions

When it is desired to ascertain the relative levels of professional civil engineering positions, they should be classified according to the relative importance of duties to be performed and responsibilities incident thereto. In this report, therefore, a general specification has been established for each classification and is intended to describe the duties and requirements usually associated with the

TABLE I. PRIVATE ORGANIZATIONS—Total Equivalent Compensation* at Entrance to Grade Shown

Data obtained from survey of February, March, and April 1951

ASCE Grade	40 Consulting Firms (1,886 Engrs)				19 Construction Firms (2,194 Engrs)				70 Private Orgns† (5,526 Engrs)			
	From (—) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range	From (—) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range	From (—) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range
1	39	$ 3,652	$ 3,377 4,045	$ 2,125 4,522	17	$ 3,917	$ 3,507 4,422	$ 3,272 5,047	63	$ 3,673	$ 3,377 4,070	$ 2,125 5,047
2	38	4,552	4,198 4,982	3,128 5,865	16	4,862	4,322 5,278	3,677 5,647	63	4,552	4,202 5,045	3,128 5,865
3	38	5,447	4,910 5,825	4,155 7,135	19	5,880	5,165 6,278	4,440 8,440	66	5,433	4,892 5,912	4,155 8,440
4	36	6,415	5,637 6,770	4,675 9,495	18	6,717	5,945 7,015	5,432 7,725	62	6,375	5,637 6,748	4,675 9,495
5	26	7,300	6,720 7,875	5,195 8,845	13	7,718	6,823 8,337	6,450 9,370	48	7,300	6,692 7,842	5,195 9,370
6	27	8,983	7,625 9,345	5,675 10,095	15	8,565	7,975 9,370	6,718 11,015	47	8,565	7,567 9,205	5,675 11,015
7	17	10,520	9,845 11,450	6,075 11,880	14	9,837	9,005 10,430	8,085 12,155	41	10,040	8,925 11,095	6,075 12,415
8	16	12,787	11,555 13,805	7,735 17,000	14	10,758	9,795 11,970	8,052 15,782	36	11,707	10,555 13,232	7,735 17,000
9	13	17,147	13,412 22,972	10,400 29,675	16	15,222	13,410 18,065	11,355 26,700	33	15,950	13,377 19,412	10,400 29,675

* Including employers' contributions to U. S. Social Security but excluding other retirement, insurance, and similar perquisites.

† Including 6 railroads, 2 public utilities, and 3 industries.

classification and the qualifications expected of the person who is to perform the work properly and discharge the specified responsibilities.

These nine ASCE grade specifications, adopted in 1946, are based, grade for grade, on statements published by the U. S. Civil Service Commission regarding its professional grades formerly identified as "P-1" through "P-9," and since October 1949 identified (without other change) as "GS-5, 7, 9, 11, 12, 13, 14, 15, and 16." The new GS number or grade designation is shown here following the comparable ASCE grade description.

It is expected that in applying this plan to organizations which do not have employees in all the nine classifications, due consideration will be given to the appropriate relationship of the various positions which exist in such organizations, and the duties and responsibilities of such positions.

Also, in large organizations, where engineering training is considered desirable for the managerial staff, men with engineering training and experience will occupy positions which are not primarily engineering in character. These positions many times will carry salaries that are compensation in part for managerial functions. These positions should not be assigned to engineering grades. The responsible engineering head of a large organization will in general be considered to be in Grade IX.

TABLE II. PUBLIC ORGANIZATIONS—Total Equivalent Compensation* at Entrance to Grade Shown

Data obtained from survey of February, March, and April 1951

ASCE Grade	22 State Hwy Depts (14,927 Engrs)				21 Municipalities (1,935 Engrs)				50 Public Orgns †(18,045 Engrs)			
	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range
1	21	$ 3,223	$ 2,650 3,572	$ 1,748 4,352	20	$ 3,730	$ 3,120 4,025	$ 2,080 5,185	46	$ 3,558	$ 3,105 3,995	$ 1,748 5,185
2	22	3,985	3,118 4,327	1,985 5,026	20	4,577	3,755 4,764	2,565 5,815	49	4,275	3,575 4,737	1,985 5,815
3	22	4,715	3,740 5,312	2,310 6,122	19	5,135	4,590 5,652	2,565 6,735	48	4,965	4,117 5,622	2,310 6,735
4	22	5,540	4,590 6,185	2,850 7,090	17	5,907	5,352 6,522	3,335 7,690	46	5,753	5,070 6,448	2,850 7,690
5	20	6,395	5,152 6,972	3,685 8,200	20	6,183	5,695 7,510	3,335 8,850	47	6,570	5,665 7,422	3,335 8,850
6	21	7,365	5,832 8,340	4,545 10,060	16	7,605	6,317 8,945	4,205 9,870	44	7,590	6,358 8,465	4,205 10,060
7	20	8,520	6,577 9,087	5,243 12,495	11	7,777	6,078 9,442	4,205 11,420	36	8,492	6,785 9,520	4,205 12,495
8	19	8,815	7,440 9,953	5,060 15,020	16	8,897	7,463 10,967	4,205 12,950	40	9,137	7,640 10,807	4,205 15,020
9	19	10,395	9,405 11,490	6,645 19,750	11	12,750	8,460 15,800	4,805 18,470	36	11,290	9,450 14,835	4,805 19,750

* Including employers' contributions to U. S. Social Security but excluding other retirement, insurance, and similar perquisites.

† Including 5 counties, a regional organization, and a large federal authority.

ASCE Grade Specifications

These classifications* include all classes of positions, the duties of which are to perform operational, creative, advisory, administrative or research work which is based on the established principles of the civil engineering profession. The fundamental prerequisite for every position to be classified in these grades is professional, scientific, or technical training equivalent to that represented by graduation from a college or university of recognized standing.

Grade I

Grade I* includes all positions which involve, under immediate supervision, the performance of fundamental civil engineering duties requiring professional training but little or no experience. (Federal GS-5)

Grade II

Grade II includes all positions which involve, under immediate or general supervision, individually or with a small number of subordinates, the performance of civil engineering duties requiring professional training, previous experience, and to a limited extent the exercise of independent judgment. (Federal GS-7)

* For clarification, the 1946 counterpart of this statement is here reworded without changing the intent of the original statement.

Grade III

Grade III includes all positions which involve, under general supervision, individually or with a number of subordinates, the performance of civil engineering duties of substantial difficulty and responsibility, requiring professional training, previous experience, and independent judgment. (Federal GS-9)

TABLE III. PRIVATE ORGANIZATIONS—Payroll Rates (adjusted to 40 hours per week) at Entrance to Grade Shown

Data obtained from survey of February, March, and April 1951

ASCE Grade	40 Consulting Firms (1,886 Engrs)				19 Construction Firms (2,194 Engrs)				70 Private Orgns* (5,526 Engrs)			
	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range
1	39	$ 3,100	$ 3,000 3,370	$ 1,800 3,850	17	$ 3,380	$ 3,090 3,600	$ 2,830 4,420	63	$ 3,100	$ 3,000 3,480	$ 1,800 4,420
2	38	3,900	3,600 4,200	2,768 4,800	16	4,050	3,900 4,450	3,180 4,950	63	3,921	3,635 4,200	2,768 4,950
3	38	4,600	4,200 5,000	3,540 6,000	19	5,000	4,600 5,470	3,950 7,420	66	4,690	4,252 5,000	3,540 7,420
4	36	5,400	4,985 5,655	4,000 6,600	18	6,000	5,100 6,160	4,800 6,600	62	5,400	4,985 6,000	4,000 6,600
5	26	6,340	6,000 6,500	4,290 8,000	13	6,820	6,400 7,000	5,750 9,700	48	6,370	6,000 6,750	4,290 9,700
6	27	7,500	6,640 8,000	4,460 9,000	15	7,510	7,000 8,000	6,000 8,500	47	7,350	6,550 7,860	4,460 9,000
7	17	8,800	8,400 9,210	5,100 10,600	14	8,735	8,200 9,000	7,200 10,000	41	8,810	8,000 9,000	5,100 10,600
8	16	10,550	9,800 12,000	6,000 15,000	14	9,800	8,730 10,000	7,200 13,000	36	10,000	9,140 11,550	6,000 15,000
9	13	15,000	11,325 22,000	9,000 25,000	16	12,800	12,000 15,550	10,000 24,000	33	14,300	11,450 17,400	9,000 25,000

* Includes 6 railroads, 2 public utilities, and 3 industries.

Grade IV

Grade IV includes all positions which involve, under general supervision, individually or with a number of subordinates, the performance of difficult civil engineering duties or the supervision of a subdivision of an engineering organization, requiring professional training, previous experience, demonstrated leadership, and independent judgment. (Federal GS-11)

Grade V

Grade V includes all positions which involve, under general supervision, individually or with a number of subordinates, the performance of difficult civil engineering duties or the supervision of a division of an engineering organization, or the direction of a staff on investigative studies, research and testing, design, or construction, requiring professional training, previous experience, demonstrated leadership, and independent judgment. (Federal GS-12)

Grade VI

Grade VI includes all positions which involve, under general direction, individually or with a number of subordinates, the performance of difficult civil engineering duties or the supervision of a division of an engineering organization, or acting as the principal assistant to the head of a division of a large engineering organization, or the direction of a staff on investigative studies, design or construction requiring professional training and successful experience in engineering work. (Federal GS-13)

Grade VII

Grade VII includes all positions which involve, under general direction, individually or with a number of subordinates, the performance of important civil engineering duties or the supervision of a division of a large engi-

TABLE IV. PUBLIC ORGANIZATIONS—Payroll Rates (adjusted to 40 hours per week) at Entrance to Grade Shown

Data obtained from survey of February, March, and April 1951

ASCE Grade	22 State Hwy Depts (14,927 Engrs)				21 Municipalities (1,935 Engrs)				50 Public Orgns* (18,045 Engrs)			
	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range	From (−) orgns	Entrance rate, median	Entrance rate, middle 50%	Entrance rate, total range
1	21	$2,725	$2,240 3,025	$ 1,500 3,720	20	$ 3,180	$ 2,780 3,328	$ 1,840 4,450	46	$3,005	$ 2,680 3,405	$ 1,500 4,450
2	22	3,330	2,730 3,685	1,680 4,295	20	3,860	3,315 4,085	2,270 4,900	49	3,655	3,085 4,050	1,680 4,900
3	22	3,980	3,285 4,530	1,955 5,232	19	4,288	4,085 4,740	2,270 5,780	48	4,250	3,600 4,780	1,955 5,780
4	22	4,590	4,035 5,133	2,412 6,060	17	4,900	4,700 5,728	2,950 6,100	46	4,910	4,285 5,400	2,412 6,100
5	20	5,540	4,600 5,760	3,120 7,008	20	5,100	4,992 6,472	2,950 7,200	47	5,590	4,920 6,208	2,950 7,200
6	21	6,265	5,050 6,900	3,900 8,520	16	6,300	5,650 7,340	3,720 7,910	44	6,470	5,600 7,200	3,720 8,520
7	20	7,200	5,550 7,812	4,500 9,385	11	6,730	5,310 7,800	3,720 9,150	36	7,200	5,725 8,005	3,720 9,385
8	19	7,700	6,360 8,495	4,440 11,400	16	7,900	6,600 9,050	3,720 10,300	40	7,945	6,585 9,050	3,720 11,658
9	19	9,000	7,735 9,990	5,700 15,000	11	10,368	6,680 12,800	4,250 15,000	36	9,550	7,980 12,300	4,250 16,658

* Including 5 counties, a regional organization, and a large federal authority.

neering organization, or the direction of a staff on investigative studies, design, or construction, requiring professional training and extensive successful experience in engineering work with demonstrated aptitude and capacity for increased responsibilities in managerial and executive functions. (Federal GS-14)

Grade VIII

Grade VIII includes all positions, such as:

(*a*) the assistant to the technical and administrative head of an important engineering organization; or

(*b*) the technical and administrative head of a lesser engineering organization; or

(*c*) positions involving the development, analysis, and evaluation, for final executive action, of difficult and complex engineering projects with respect to their feasibility, cost, economic justification, and public necessity or convenience. (Federal GS-15)

Grade IX

Grade IX includes all positions, such as:

(*a*) the administrative and professional head of an important engineering organization with full authority and responsibility for conceiving and executing all the plans and functions of the organization, directing an administrative and professional engineering staff engaged in varied important projects; or

(*b*) positions requiring highly specialized professional engineering or scientific ability. (Federal GS-16)

The figures in Tables I and II represent total equivalent compensation corresponding to the entrance rate for each grade shown. They were computed by first converting all reported salary rates to the equivalent of a 40-hour week (see Tables III and IV) and then adding to the converted payroll rates the dollar value of such tangible perquisites as bonus, U. S. Social Security (payments by employer), holidays, annual leave or vacation time, and total annual allowance for sick leave. Employers' contributions to other retirement, insurance, or similar plans were excluded from the computation (see Supplemental Data below) as were a few of the above perquisites when the data received could not be converted into dollar values.

Let y = total equivalent compensation (payroll rate plus the dollar-value of tangible perquisites listed); from Tables I or II

x = payroll rate for entrance to a particular grade in a particular organization

a = normal number of hours worked per week

40 = adopted "standard hours per week" for purpose of the survey

b = bonus, in percentage of salary rate

s = employers' contribution to U. S. Social Security Plan, in percentage of not more than $3600 of salary rate. For 1951, the rate is $1\frac{1}{2}$ percent, and the maximum contribution (on $3600 of pay) is $54.

h = number of holidays (workdays, excluding Saturdays and Sundays)

v = number of days of annual leave or vacation (workdays, excluding Saturdays, Sundays, and holidays)

c = maximum number of days allowed annually for sick leave (workdays)

261 = total number of workdays per year (365 less 52 Saturdays less 52 Sundays)

To compute the total equivalent compensation (including U. S. Social Security but excluding other retirement plan perquisites) corresponding to a payroll rate x, use the formula:

$$y = x\left[\frac{40}{a} + sx^{*} + b + \frac{(h+v+c)}{261-(h+v+c)}\right] \quad \ldots (1)$$

To reverse this process and convert the total equivalent compensation at entrance to a particular grade (values from Tables I or II) to the corresponding payroll rate for a particular organization, taking account of the dollar value of its own tangible perquisites (including U. S. Social Security but excluding other retirement plan perquisites):

$$x = \left[y - (sx \text{ or } \$54)\right] \div \left[\frac{40}{a} + b + \frac{(h+v+c)}{261-(h+v+c)}\right] \quad \ldots (2)$$

Make a tentative computation (x_t) using $y = \$54$. If x_t is greater than $3,600, its value is correct. If y or x_t is less than $3,600, recompute using $y - sx_t$. Any resulting error in the value of x will be insignificant.

* Value of sx not to exceed $54 per year.

Subprofessional Positions

Subprofessional grades or classes have been omitted from this study. Subprofessional grades form one or more separate series frequently overlapping the professional series by two or three grades. They encompass groups of specialized positions in which high skill in a narrow field is exercised and for which training or education equivalent to that in a degree-granting curriculum is not prerequisite.

Intangible Employment Conditions:

The following factors cannot be converted readily into dollar equivalents, but they are valuable and some are decisive in employer-employee relationships. Estimates of their value will be highly personalized:

- Character and reputation of the individual employee or applicant
- Qualifications of the employee or applicant to fill a position
- Character and reputation of the employer organization
- Probability that the organization will retain its stability
- Probability that the organization will retain its present size and scope, will expand, or will shrink
- Security or continuity of employment, including chances of being hired later by a different organization, especially in latter half of career
- Existence of an active merit or service rating system, including apparent effectiveness of its administration
- Evidence of the employer's appreciation of the employee's performance, trustworthiness, and loyalty
- Morale among employees of the organization
- Chances of administrative salary raises (without promotion)
- Chances of advancement to higher positions
- Probable ceiling that the employee may expect to attain among positions in the organization
- Special personal qualifications of the employee not utilized presently or in the foreseeable future
- Specialization versus diversity of work as it may affect future positions with the organization or with some other organization
- Probability of accidents or impairment of health (usually taken into account in establishing salary rates)
- Cost of living (here classed as intangible because of variations in personal taste and adaptability)
- Living conditions for self and family including the home, community environment, off-duty relaxation and entertainment, educational and church facilities for children or self, and proximity to relatives, friends, social organizations, etc.
- Compelling financial or moral obligations to family, relatives, etc.
- The employee's general willingness or resistance to change

Occasionally such positions may be filled temporarily by engineering graduates, but the typical incumbent usually will have graduated from high school and perhaps from a technical institute (where one-, two-, or three-year terminal courses in a special field lead to a certificate but not a degree).

The great importance of subprofessional positions is recognized by professional engineers. Omission of coverage of subprofessional positions in this report is due simply to the Society's preoccupation with positions at professional levels.

In the above discussion the professional series of grades referred to starts with graduation from college or its equivalent (Grade I), and this is the concept most frequently encountered. It may be noted, however, that in certain jurisdictions (for example, Los Angeles County) the first professional grade is construed to be higher—at least at the level of Grade III in the grade specifications reproduced in this report—with state registration or license as a prerequisite. The concept of subprofessional grades in such jurisdictions will therefore include at least two levels between graduation and the first professional grade. In such instances, grade levels must be determined on the basis of duties and responsibilities and not on whether the designation is professional or subprofessional.

Supplementary Data from the Survey

Hours of Work per Week:

Eighty-two percent of private firms and 53 percent of public agencies reported 40 hours as the normal work-week. Range of replies was from 35 to 50 hours. Field staffs in five units work longer hours than office staffs (44, 44, 45, 48, and 50 hours versus 40, 40, 40, 38, and 44, respectively).

Holidays:

Seventy-four percent of private firms observe 5, 6, or 7 holidays, with 40 percent giving 6. Range is from 5 to 12. Sixty-seven percent of public agencies observe 10, 11, 12, or 13 holidays; 31 percent give 11. The range is from 6 to 15.

Annual Leave or Vacation:

Seventy-eight percent of private firms allow 10 work days for vacation (two calendar weeks). Range is 9 to 18 work days. Thirty percent of public agencies reported 10 work days for vacation; 28 percent reported 12; and 18 percent reported 15. The range is 9 to 26 work days.

Sick Leave:

Fifty percent of the private firms reported that they have no formal number of days' allowance for sick leave. Of those that have an allowance, 47 percent favor 10 work days, the range being from 5 to 20 work days except for one consultant and two contractors that reported zero sick-leave allowances. Thirty-nine percent of public agencies allow 12 work days; 22 percent allow 15; and 16 percent allow 10. The range is from 9 to 30 work days. One public agency allowing no sick leave is offset by one that allows all that is necessary.

There is known to be a great variety in the provisions for sick benefit plans, such as when the allowance starts (immediately, or after so many days of illness), scaled allowances according to length of service, etc. For this report only the number of days' allowance could be considered.

Bonus:

Thirty-three consulting engineers out of 41 pay a bonus to their employees, from 2 percent up and averaging between 7 and 8 percent, or about four-weeks' salary. The data reported by 25 permitted, with a little estimating, the inclusion of the bonus in the survey data. The data reported by 8 firms could not be computed.

Fifteen construction firms out of 19 also pay a bonus and at about the same average rate as the consultants, but the data from only 5 could be computed and added to the survey data.

U. S. Social Security:

U. S. Social Security Accounts for their employees are carried universally by private organizations that employ civil engineers except railroads, whose employees are covered by the Railroad Retirement Act. The public agencies that responded to this survey included no Social Security Accounts.

Retirement Plans:

Retirement plans for employees, other than U. S. Social Security, were reported in effect in 24 percent of consulting engineering firms, 37 percent of construction firms, all 6 railroads that furnished data, 21 out of 22 state highway departments, 72 percent of municipalities, and all 5 of the counties that responded. Thus 37 percent of the private, and 86 percent of the public organizations that reported have retirement plans for their employees. The retirement item on the survey questionnaire was not properly phrased, however, and the resulting information did not permit computation of the dollar value of this perquisite. The contributions reported by 18 employers ranged between 3 percent and $7\frac{1}{2}$ percent of salary, 5 percent and 6 percent being the most frequent.

Cost-of-Living Index:

Inquiry was made as to whether the organization's salary structure contained a cost-of-living index as a factor. Nine private firms said yes. Six of them—all consultants—said it was not a formal factor but was considered in adjusting rates. One county, among seven public organizations that use the factor, said that it took a cost-of-living index into consideration.

Professional Attitude

Engineering is a profession and engineers think and act accordingly, not only in public and technical matters but also in such business matters as employer-employee relationships in the field of employment conditions and salaries. The employer and the employee each have rights and privileges which should be respected, but they also have obligations towards each other.

The Engineer-in-Training movement instituted by many States under the provisions of their Registration Laws for Professional Engineers has as a prime objective the inculcation of a professional attitude in young engineers following graduation and prior to their meeting the full requirements for registration or licensing as a Professional Engineer.

Security

Continuity of employment (security) is known to be an important factor to employees. For an engineer to give too much weight to this condition of employment may be unfortunate as he may run the risk of stagnation and lost opportunity. Nevertheless, the probability of continuity of employment in a particular organization, or the probability that he can secure equivalent or better jobs with other organizations, must be considered by the employee in evaluating the worth of an engineering position.

Respectfully submitted,
Z. E. Sevison
R. E. Lawrence
H. E. McGee
P. L. Holland, *Contact Member*
A M Rawn, *Chairman 1950*
R. A. Monroe, *Chairman 1951*

ASCE COMMITTEE ON SALARIES
10 June 1951

(American Society of Civil Engineers, 33 West 39th Street, New York 18, N.Y.)

Ohio Valley Commission pioneers in regional stream cleanup program

THE OHIO River Valley Water Sanitation Commission is an agency that has been created by local demand, in response to local needs, and which is under the direction of, and staffed by, local people. It is an important experiment in regional planning which reverses the currently popular trend of centralizing authority in Washington.

The Commission provides an agency for the coordination of interest, the establishment of policies, and the execution of programs whereby each of its eight signatory states can jointly advance the regional program of stream cleanup.

Passing now to the specific details of Commission activity, here are some of the things that have been accomplished. One of the Commission's first actions was to establish a water-quality objective in the Cincinnati Pool, a 22-mile stretch of the Ohio River. This involved technical investigations and a public hearing on the basis of which information could be given to the city of Cincinnati, Ohio, and to 16 municipalities in the Commonwealth of Kentucky across the river enabling them to proceed with the design of treatment works. Already construction of a sewage-treatment plant in Cincinnati has started. In the Kentucky cities, the sanitation district that was formed to execute a joint program has begun construction of collector sewers, and treatment-plant construction is scheduled to start this fall.

Investigations also have been made at Pittsburgh and other major cities on the Ohio River relative to sewage-treatment requirements. In a river 981 miles in length there are many variables, and no single requirement for treatment is applicable. Nor does a single standard apply to interstate tributaries.

The Commission has also completed an analysis of pollution loads in a 100-mile stretch of the Wabash River, a major interstate tributary. With this evidence, the states of Indiana and Illinois are in a position to strengthen any legal action that may be needed to insure installation of treatment facilities. It is gratifying to state that since this report was completed the city of Terre Haute has contracted for completion of final plans leading to construction of its treatment plant.

After a year's study, objectives for the Ohio River as regards bacterial quality have been published. (See Fig. 1.) These findings set forth a basis on which the Commission can reach decisions concerning acceptable limits and control of bacterial contamination for both water supply and recreational uses. Heretofore the task was complicated by a wide divergence of viewpoints and standards throughout the nation.

Although the Commission does not propose to engage in research, it does feel the responsibility to inspire and coordinate investigations where they are needed to accelerate the construction of waste treatment works.

Such was the case with regard to phenol removal. By-product coke plants in the Ohio Valley—as indeed elsewhere in the nation—have not fully succeeded in modifying their discharge of wastes to a point where water supplies can be freed of taste and odor. This difficulty led the Commission to sponsor a cooperative research project. With the generous support of industry and other elements of private enterprise, harnessed to the aid available from three public agencies, the project has been completed and the findings have just been published. The report, which may be obtained on request to the Commission, sets forth new information on phenol treatment, offering a valuable guide to the Commission and to industry looking toward the ultimate improvement of water quality.

One of the most fruitful undertakings has been the initiation of "Industry Action Committees of the Ohio River Commission." These committees are the offshoot of exploratory conferences conducted by the Commission with management representatives of allied industry groups in the Ohio Valley. More than a year ago the Commission met independently with the steel producers, chemical-brine industries, distillers and metal-finishing industries. Each of these groups has established action committees of the Commission. These committees have been hard at work—and have kept the staff of the Commission busy—in promoting joint research, development of standards, and preparation of manuals of waste-treatment practice, and in promoting treatment installations in their own plants.

As a result of these efforts in the Ohio Valley, where there exists such a community of interest, the Commission feels that much can be accomplished by an extension of such relationships. Plans are going ahead in this direction.

Other work of the Commission related to stream cleanup includes the formulation of legislation within the states looking toward uniformity; technical studies on stream behavior and waste loadings; and promotional campaigns in various cities using specially designed exhibits, motion pictures, telecasts and booklets.

Strength of Commission Tested

No one must be under the delusion that the organization of the Commission has created a magic wand, the simple waving of which will bring pollution problems to an end. However, formation of the Commission has, for the first time, provided a mechanism for integrating the efforts of state regulatory agencies, the federal government, the industries and the people of the Ohio Valley.

Like any new piece of machinery, this mechanism must be tested and adjusted in order to insure proper functioning. One such test has just been completed—a test that had never before been made with regard to the power potentials of interstate compact machinery.

The basic question arose when the Supreme Court of Appeals of West Virginia ruled in a 3-2 decision last year that ratification of the Ohio River Compact by the State Legislature was unconstitutional. When this ruling was reviewed by the U.S. Supreme Court, that body reversed the state court. The decision was that the delegation, by a state, of police power (authority) to an interstate agency for the regulation of waste discharges was reasonable and legitimate. A second point of significance in the decision handed down by the U.S. Supreme Court is that questions of interpretation of an interstate compact go beyond the unilateral jurisdiction of a state court, and can be resolved only by action from the highest court

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of the nation. The West Virginia situation, as well as many other aspects of Commission activity, thus reveals the pioneer nature of what is being attempted in the Ohio River Valley.

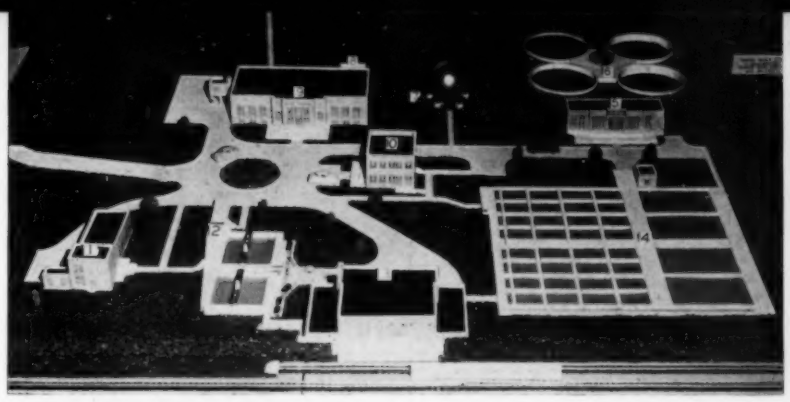
There are those who look on this venture as an experiment in American government. Some see the compact program as a vast educational campaign to awaken social responsibilities; education, coupled with enforcement where that becomes necessary, should create acceptance of those responsibilities. And others conceive the compact group as a body concerned with the establishment of economic balances and the application of engineering skills—a viewpoint with which technical and management men should be in harmony. Those who are charged with execution of the Ohio River Valley program acknowledge it to be all these things.

But the success of the program cannot be shrugged off as the sole responsibility of a group of commissioners and their staff. The success of the program ultimately will be a measure of how sincerely the people, the communities in which they live, and the industries of the region rise to the challenge of their responsibilities. An editorial in the Louisville *Times* not long ago stated:

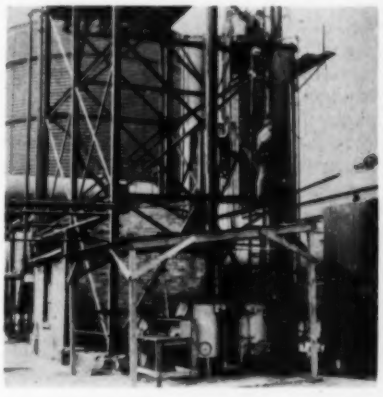
"A modern sewage disposal system here is long overdue. So long as Louisville empties its sewage into the Ohio with utter disregard for towns and cities downstream from us we cannot with good conscience expect better treatment from our neighbors upstream. Only by putting our own house in order can we reasonably demand that others stop polluting our source of drinking water."

Note how clearly this editorial writer states the problem and proposes the remedy: "Only by putting our own house in order can we reasonably demand that others stop polluting our source of drinking water." This is sound philosophy for the entire Ohio River Valley. And the Commission will do its utmost to translate this philosophy into action.

This article is based on the paper originally presented by Mr. McCleary at the ASCE Louisville Convention, at the Sanitary Engineering Division session, presided over by B. A. Poole, M. ASCE.)



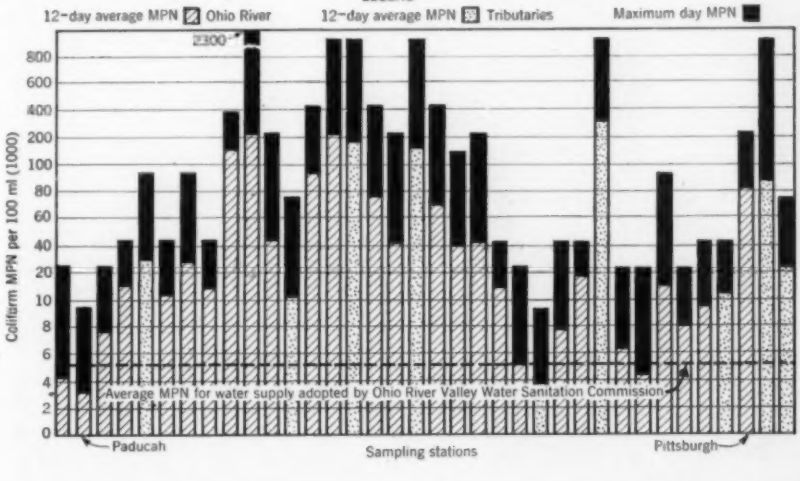
CONSTRUCTION HAS STARTED on Cincinnati's Little Miami sewage treatment plant, to provide primary treatment augmented with pre-aeration, chemical flocculation, sludge digestion and incineration. Plant (model of which is shown) will help meet water-quality standards set by Commission for Cincinnati Pool, 22-mile stretch of Ohio River.



AT PILOT PLANT for investigation of phenol-waste treatment, three methods of chemical oxidation were developed for destruction of phenols—using chlorine, oxone, and chlorine dioxide. Plant was operated at Hamilton coke works of Armco Steel Corp. under direction of Ohio River Valley Water Sanitation Commission. Results of investigation have just been published, and copies may be obtained by addressing Ohio River Valley Water Sanitation Commission.

INDUSTRIAL WASTE CONTROL is vital element in Ohio River Valley clean-streams campaign. New plating-waste treatment plant shown has been placed in operation by Electric Auto-Lite Co. at Lockland, Ohio.

FIG. 1. **PATTERN OF** bacteriological pollution was established by round-the-clock simultaneous sampling of 963-mile stretch of Ohio River at 36 points in September 1950. Seriousness of domestic sewage load is shown by comparison with water-quality objective established by Commission.



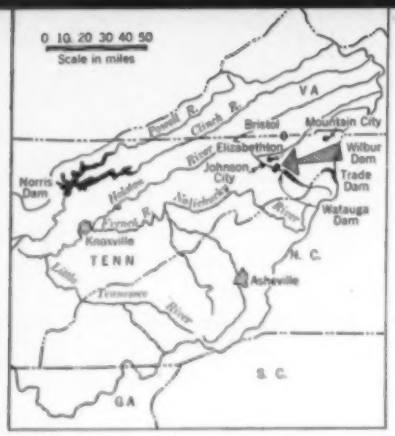


FIG. 1. WILBUR DAM and Powerhouse is located on Watauga River about 2½ miles below Watauga Dam.

Forty-year-old Wilbur

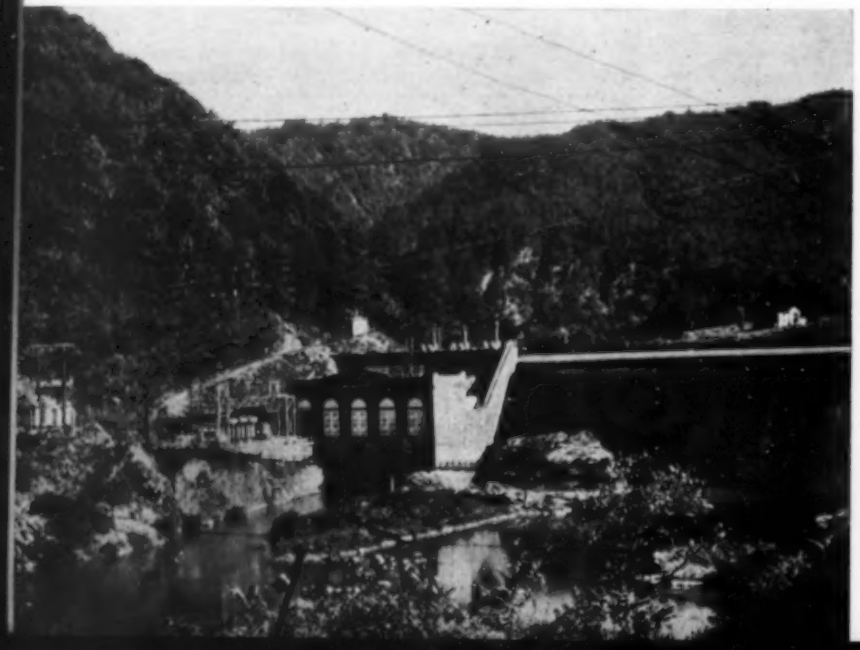
MANY ARTICLES on hydroelectric projects deal with exceptionally large developments, difficult construction problems, or unusual features of planned operation or design. This story is at the other extreme, for it concerns a small and middle-aged hydro plant; it is the story of a face-lifting and rejuvenation job to meet new conditions rather than of a new development.

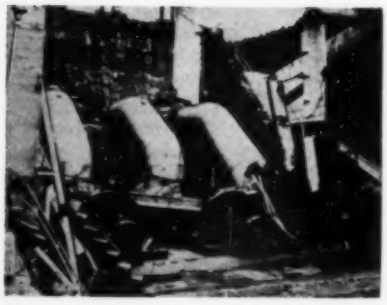
The 40-year-old Wilbur plant, now a unit in the TVA system, is at the downstream end of the gorge cut by the Watauga River as it flows through the mountains of upper East Tennessee (Fig. 1). The history of the plant since its construction includes the addition and rebuilding of generating units, partial destruction by flood, and finally the major improvements to the dam and power facilities recently completed by TVA's construction forces.

The addition of a 7,000-kw unit as a part of this recent rejuvenation increases the total plant capacity to 11,000 kw, enough to develop practically all the energy potentially available from the stream flow as regulated by the Watauga project, which is located 2½ miles upstream from the Wilbur plant. (See "Planning the Watauga Project," by George K. Leonard and Don H. Mattern, in CIVIL ENGINEERING for March 1948.) The provision of Tainter gates for spillway control will decrease the waste of water as compared with flashboards, and also will reduce operation and maintenance costs.

Construction of the Wilbur project was begun in 1910 at a point known as Horseshoe Bend on the Watauga River eight miles upstream from Elizabethton, Tenn. The energy developed was to be transmitted to Bristol, Tenn.-Va., and to Elizabethton, for distribution by local companies formed for that purpose. Early plans called for extension of the transmission lines an additional eight miles to Johnson City in the event there should be a surplus from the 2,000-kw plant after power was supplied to the first two cities!

The dam was gravity type, built of approximately 16,000 cu yd of cyclopean concrete, the large stones being quarried at the site. Its total length was 368 ft, 240 ft of which was an uncontrolled overflow spillway with a design discharge capacity of 32,000 cfs. The structure was approximately 70 ft high from bedrock to spillway crest, the maximum poor level evidently having been set so as not to interfere with the then important branch line of the Southern Railway connecting Johnson City with Mountain City, the center of an extensive lumber manufacturing industry. The powerhouse was 80 ft long by 34 ft wide, built of reinforced concrete with brick spandrel walls. The concrete roof girders were designed to carry a concrete roof although a wood-sheathed one was installed.





hydro project rejuvenated

Flood damage repaired and capacity increased

DON H. MATTERN, M. ASCE

Assistant Chief, Project Planning Branch, Tennessee Valley Authority, Knoxville, Tenn.

The initial power installation was two horizontal, Francis-type, S. Morgan Smith turbines direct-connected to 1,250-kva, 0.8-power-factor, 2,200-v, 60-cycle Westinghouse generators. Each turbine consisted of two 950-hp, 33-in.-dia runners on one shaft and housed in a steel wheel casing on the upstream side of the powerhouse.

In 1926 James Leffel and Co. installed a vertical unit in the vacant stall on the river side of the powerhouse. This Francis turbine is a 45-in., type-F runner, rated at 1,840 hp, 55-ft head, and 277 rpm. The direct-connected Westinghouse generator is rated at 1,500 kva, 0.8 power factor, 1,200 kw, 2,300 v (Fig. 1). In 1928 S. Morgan Smith Co. rebuilt one of the original horizontal wheels, and the next year Leffel rebuilt the other. New runners, gate cases, and other inside parts were installed but the original housings were not altered.

The mid-August 1940 storm caused floods on the headwaters of the Watauga River that exceeded all previous records. Precipitation over the 471-sq-mile drainage area above Wilbur Dam averaged 6.5 in., with a maximum of 15 in. at Trade, Tenn. At Wilbur, the river rose rapidly during August 13, until by late evening the water was overtopping the dam and running into the generator room to such an extent that the operators had to abandon the plant. At the time the river reached its peak, the flow was estimated to be 72,000 cfs, and water 5 ft deep was pouring over the non-overflow section of the dam. The force of the flood was too much for the superstructure, which was completely crushed and carried downstream.

Repair work started immediately after the flood had subsided. Although some of the equipment was replaced, the major pieces were cleaned and dried and returned to service. The first turbine went back on the line on October 3, only seven weeks after the flood. However, the reconstruction work was not completed until about July 1, 1941.

Integrated with TVA System

At the time construction was first started on the Watauga project, in February 1942, the Wilbur plant was owned by the East Tennessee Light and Power Co., a subsidiary of Cities Service Power and Light Co. Negotiations between the power companies and TVA were initiated with the view of reaching an operating agreement taking into account the effect of stream-flow regulation by Watauga on the output at Wilbur. When construction of Wautauga was halted on order of the War Production Board these negotiations were discontinued. Later, when Cities Service was ordered by the Securities and Exchange Commission to dispose of its holdings in the East Tennessee Light and Power Co., under the Public Utility Act of 1935, the TVA pur-

WILBUR DAM, gravity-type structure 70 ft high, was built on Watauga River in 1910. (See view at far left, facing page.) Powerhouse (left) contained two 1,250-kva Westinghouse generators, each driven by horizontal 33-in.-dia double-runner S. Morgan Smith turbine. In 1926, third generator was installed—1,500-kva Westinghouse driven by 45-in. vertical Francis turbine. Flood of 1940 rose 5 ft higher than non-overflow section back of powerhouse, carried away powerhouse superstructure, and left wreckage shown at lower left.

AS REBUILT IN 1941 (right), Wilbur plant had capacity of 4,250-kva with spillway controlled by 4½-ft-high wooden flashboards. In this condition plant was acquired in 1945 by Tennessee Valley Authority from East Tennessee Light and Power Co., and redesigned for coordination with TVA's Watauga multiple-purpose project, 2½ miles upstream.

RECONSTRUCTION of Wilbur Dam and Powerhouse by TVA got under way in 1949 during final stages of construction of Watauga Project. Pool was raised 5 ft. Spillway was lowered 5 ft to accommodate Tainter gates, and dam cross section was thickened about 4 ft. In view at left, gap adjacent to existing powerhouse has been cut for additional 7,000-kw generating unit. Reservoir silting can be seen upstream. In view at right, silt in front of trash racks to three existing units, in foreground, has been removed.

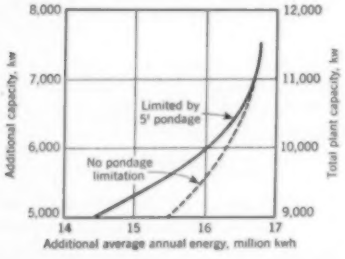


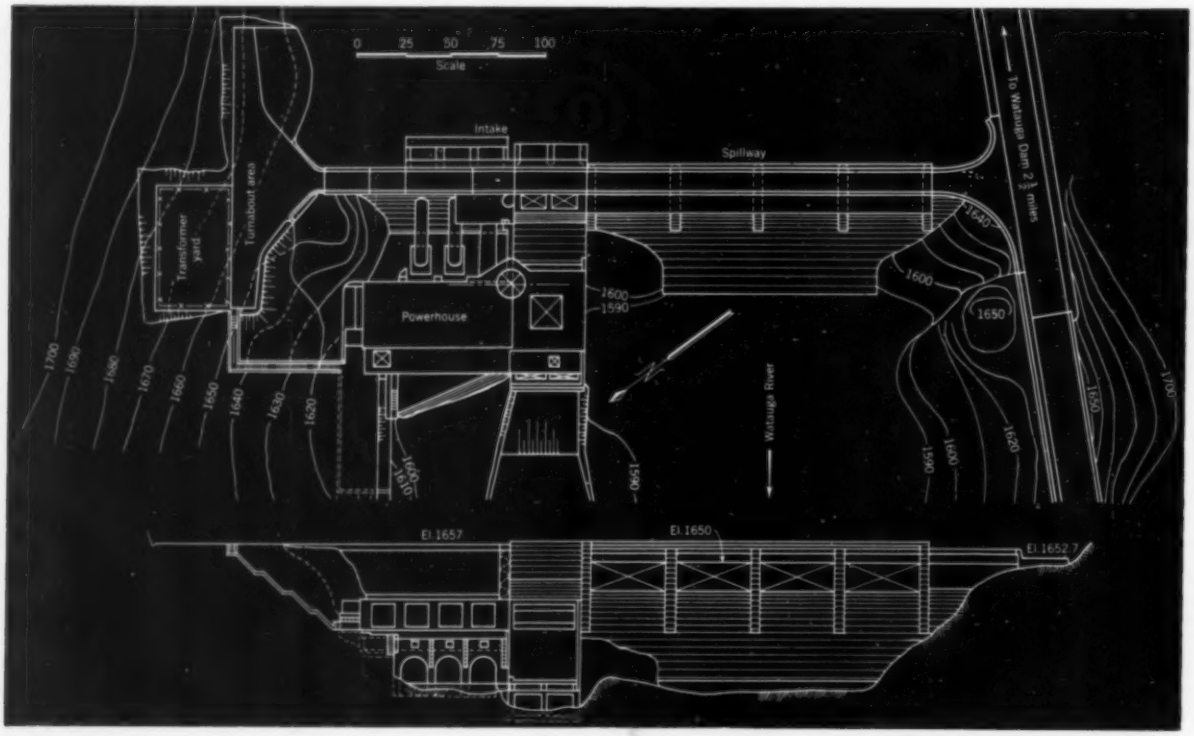
FIG. 2. CURVES prepared in power study for Wilbur plant, based on water released from Watauga Dam 2½ miles upstream, indicated advisability of adding 7,000-kw unit at Wilbur to raise total capacity to 11,000 kw.

FIG. 3. PLAN and downstream elevation of reconstructed Wilbur hydro project show additions made in TVA reconstruction in 1949–1950. Operation of three original units and new 7,000-kw unit is coordinated with that of the Watauga plant upstream.

chased the generating plants and transmission lines owned by that company, and the municipalities and cooperatives in the area bought the distribution systems. In this way the Wilbur project became part of the TVA system on June 29, 1945.

The East Tennessee Light and Power Co. owned sufficient land about Wilbur Lake to permit raising of the normal pool from El. 1645 to 1650. Plans for such work were being considered at the time the TVA's Watauga project was started, and therefore were taken into account in planning that project. On acquisition of the Wilbur development, the feasibility of extending the Watauga power tunnel and combining the power potentialities of the Watauga and the Wilbur sites in a single project having the powerhouse located in the vicinity of Wilbur was explored. Economic analyses indicated that, although the scheme was practical, it was not as attractive as the two-plant plan finally adopted.

Construction of the multiple-purpose Watauga project completely changed the stream-flow pattern at Wilbur. The large useful storage capacity of the Watauga Reservoir, equal to the entire runoff in an average year, makes it possible to exercise a high degree of seasonal regulation. Storage releases will substantially



PERMANENT 40-ton stiffleg derrick installed on top of powerhouse (May 1949) facilitates construction operations. Note (in view at left) deeper setting of new propeller-type unit, and tailrace weir installed below older Francis-type units to seal draft tubes. In view at right, spillway has been raised to final height; Tainter gates and trash racks are being installed.

increase the flow normally available at Wilbur during the low-flow season (usually September through November in the Tennessee Valley), and will practically eliminate periods of high flow. Average weekly discharges from Watauga will range from a nominal minimum release to about 2,000 cfs and will be about 850 cfs or greater 50 percent of the time on the average. However, during periods of peak-load operation, the discharges from Watauga are expected to be in the order of 2,400 to 3,500 cfs, depending on load requirements and the available head for the turbines.

Studies made following the acquisition of the Wilbur project indicated that, although considerable quantities of additional energy would become available as a direct result of stored water being released from the Watauga Reservoir, the discharge capacity of the three existing Wilbur units was woefully inadequate to pass anticipated Watauga releases through the turbines. Hydrographic surveys revealed that pondage between Wilbur and Watauga was no longer available because of the accumulation of silt over the years, and consequently all Watauga discharges greater than the Wilbur discharge capacity necessarily would be wasted over the Wilbur spillway. Such wastage was particularly objectionable because the 4.5-ft flashboards would often go out, resulting in both waste of water and high maintenance cost for frequent flashboard replacements.

With the resumption of construction activities at Watauga in July 1946, several factors indicated the desirability of making proposed improvements at Wilbur during the latter stages of the Watauga construction program, particularly in the period when the reservoir was being filled for the first time. It was thought, and subsequently found to be true, that construction economies could be achieved by timing the improvement work so that it could be handled by the well-organized and

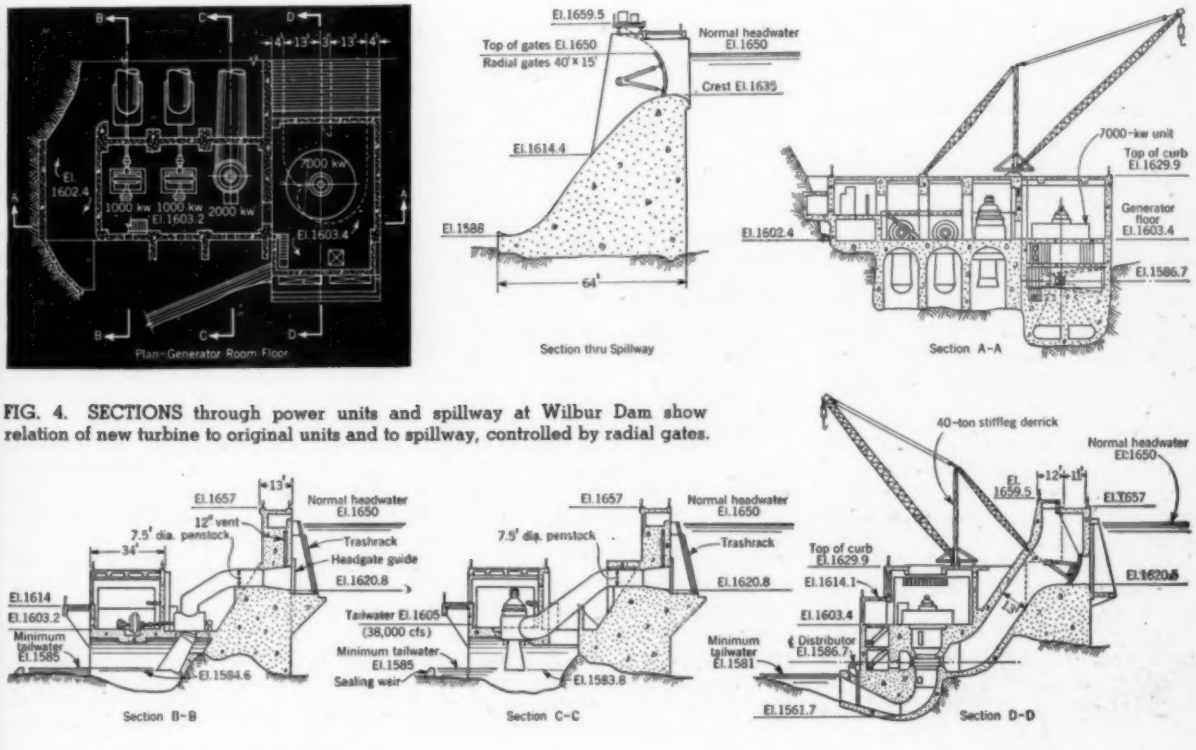


FIG. 4. SECTIONS through power units and spillway at Wilbur Dam show relation of new turbine to original units and to spillway, controlled by radial gates.

efficient Watauga forces as an extension of that program. For one thing, with this arrangement, construction camp and major construction shops were unnecessary at Wilbur because of the nearness of these facilities at Watauga. Also, cofferdamming and diking, where necessary, were a simple matter since the stream flow from all but 3 sq miles was cut off by initial filling of the Watauga Reservoir. Then, too, postponement of work at Wilbur would have resulted not only in loss of energy due to insufficient discharge capacity and relatively poor unit efficiencies, but also in high operating costs because of the "expendable" flashboard-controlled spillway.

Wilbur Power Facilities Planned

Determination of the energy that might be produced by installing additional generating capacity at Wilbur was based on anticipated weekly load-factor operation at Watauga, as well as on seasonal use of the available storage in the Watauga Reservoir. The estimated amounts of energy to be obtained from various additions to the original plant capacity for different pondage provisions are shown in Fig. 2.

It appeared from these curves that the addition of one 7,000-kw unit, making a total plant generating capacity of about 11,000 kw, together with 5 ft of pondage below El. 1650, would be sufficient to utilize practically all the controlled inflow without appreciably restricting the flexibility in load-factor operation at Watauga. A larger installation at Wilbur would have required a somewhat smaller pondage fluctuation and thereby would have slightly increased the operating head on the plant; however, no appreciable further gain in energy would have been obtained, as indicated by the Fig. 2 curves. On the other hand, a total installation of less than 11,000 kw would have resulted in greater spillage, or would have required a wider pondage fluctuation accompanied by a head reduction and a loss of energy.

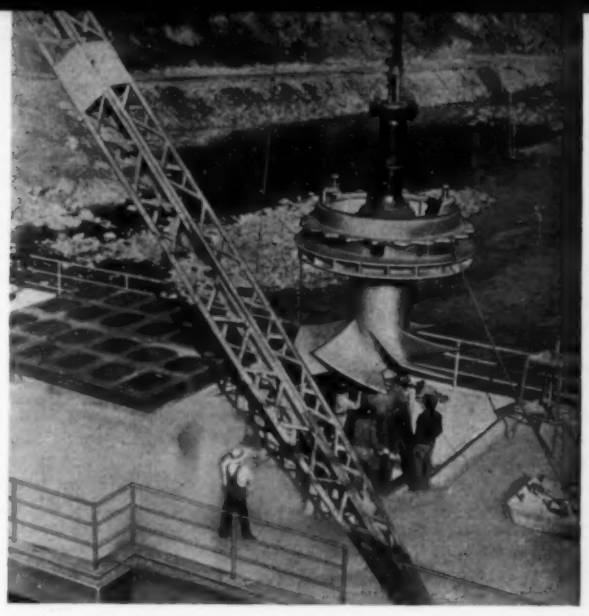
It was estimated that the output of the unimproved Wilbur plant would be 12,700,000 kwhr per year on the average after construction of the Watauga project, as compared with 29,400,000 kwhr if improvements were made, a gain of 16,700,000 kwhr. The potential primary power of the system, estimated on the basis of dry-year conditions, will be increased by 3,200 continuous kw. This large percentage increase of potential energy can be traced directly to the tandem-type operation of the two plants. The Wilbur project, in effect, thus becomes an extension of Watauga, with the two plants functioning practically as one as regards power operation.

In determining the size of the generating unit to be added to the Wilbur powerhouse, the primary consideration was the necessity of obtaining sufficient discharge capacity which, in conjunction with the older turbines, would efficiently handle the controlled discharge from the Watauga project. As previously mentioned, study of the power added by different sized units indicated that one having a capacity of 7,000 kw would develop practically all the potential energy available. The small variation in operating head, together with the fact that the unit can be operated at near optimum gate opening most of the time, suggested the use of a fixed-blade propeller turbine as the prime mover. Studies indicated that an installation using this type of runner would be more economical for the Wilbur installation than either a Francis or a Kaplan runner, and consequently it was adopted. The James A. Leffel runner which has been installed is 115 in. in diameter, operates at 180 rpm and is rated 9,700 hp at a 58-ft head.

The generator is rated at 7,000 kw, 7,777 kva, 0.9 power factor, 2,300 v, and was manufactured by the Elliott Co. of Ridgeway, Pa. This new unit is remotely controlled from the control building at the Watauga project, although the old units will continue to be started and stopped manually. Energy generated at Wilbur is stepped up to 66 kv by transformers located in the new switchyard built at that plant and tied in with the switching center at Watauga.

General plans and sections of the powerhouse are shown in Figs. 3 and 4. Several features of the existing structures exerted considerable influence on the building for the new unit. The more conventional type of reinforced concrete intake used under heads such as are encountered at Wilbur was not practical in this instance because of the construction difficulties and cost involved in breaching the existing bulkhead section of the dam.

Early studies showed that a steel scrollcase and penstock, even at this low head, would be the most economical solution to the problem. However, steel-pipe deliveries were so slow at the time the work was scheduled that it was decided to use a concrete box type of intake passage for the new unit. The downstream face



RECONSTRUCTED WILBUR DAM and Powerhouse (seen from downstream and upstream on facing page) were completed and in operation in October 1950. Work was done by TVA forces at cost of about two million dollars. Wilbur power plant operates in tandem with Watauga plant.

COMBINED RUNNER, shaft, and cover plate for fourth unit in Wilbur Powerhouse is lowered into place (right). Vertical-shaft propeller-type turbine for this unit is rated at 11,500 hp, 180 rpm, 67-ft net head, or 64-ft effective head. Turbine was manufactured by The James Leffel & Co., Springfield, Ohio.

of the existing dam forms the base of the water passage, while the pier, walls, and top were constructed independently. Two 13 × 13-ft Tainter gates function as intake gates and normally will be in the open position. Conventional trashracks are used, in an arrangement similar to that of the old units.

When the powerhouse was rebuilt following the 1940 flood, the walls and roof were designed to withstand a load equivalent to a 5-ft depth of water. Construction was reinforced concrete. This unusual provision was fully utilized in the design of the new section of the powerhouse. A stiff-leg derrick was set up near one corner of the building and used for turbine and generator erection. The derrick has a capacity of 40 tons and is a permanent installation which will be available for turbine and trashrack maintenance and for operation of the radial intake gates.

The roof of the old powerhouse was used as erection space for equipment for the new unit, and will continue to be used as a deck for general maintenance work in the future. Fortunately, because of this circumstance, it was possible to reduce the space about the new unit to a minimum. All equipment used in the interior of the powerhouse enters through a hatch in the roof and is handled by the 40-ton derrick.

A series of shoals and pools extends for some distance downstream from the Wilbur powerhouse. The shoal just below the existing tailrace controlled the minimum tailwater level. The crest of the next shoal some 1,500 ft farther downstream was about 3 ft lower. By cutting a channel about 600 ft long through the first shoal, the effective operating head was increased, with a resulting gain in plant output.

The setting of the new unit was established in relation to the lowered tailwater. To insure seal on the draft tubes of the old units, however, it was decided to build a tailrace weir which would allow them to operate under former tailwater conditions for the lower flows.

Wilbur Dam and Spillway Reconstructed

Stability analyses of the Wilbur Dam indicated that it did not provide as great a factor of safety as is usually planned and built into modern structures. Consequently, when it was raised from El. 1650 to 1657, additional concrete was required not only to increase its height but also to increase its cross-section enough to obtain a factor of safety consistent with good practice.

The reconstructed spillway is 185 ft long and consists of four 40-ft openings and five 5-ft piers. The four 40 × 15-ft Tainter gates are operated by individual hoists. At maximum pool level the spillway will pass 36,000 cfs. The spillway crest was lowered from El. 1640 to 1635, and the shape changed to accommodate the new gates. Enough of the old crest concrete was removed so that the minimum thickness of new concrete would be approximately 4 ft.

Existing concrete on the downstream face of the overflow section was roughened, dowels were inserted, and new concrete was added. The slope, originally 0.68 horizontal to 1 vertical, was increased to 0.7 horizontal to 1 vertical, and the bottom width of the maximum section was increased from 59 to 64 ft. An 11-ft roadway extends across the dam, with a turnaround at the powerhouse end of the structures. No apron was provided for the spillway because of inherent resistance to erosion provided by the massive beds of quartzite on which the structure is founded.

The cost of altering the dam and spillway, adding the 7,000-kw unit to the plant, and making necessary additions to the switchyard, was estimated to be $1,825,000. Incomplete cost figures indicated that the final cost of these improvements will be somewhat higher than the original estimate, largely because of the rapid increase in cost of both labor and materials just prior to and during the construction period.

Project planning investigations for the TVA are made under the supervision of C. E. Blee, Chief Engineer; under the general direction of James S. Bowman, Chief Water Control Planning Engineer; and under the direct supervision of Reed A. Elliot, Chief of the Project Planning Branch. The latter contributed greatly to this article by his many helpful suggestions. Detailed power studies are made under the supervision of Dana M. Wood.

Design of the redevelopment work at Wilbur was under Robert A Monroe, Chief Design Engineer, while construction was supervised by George K. Leonard, then Project Manager, Upper Holston Projects, and now Chief Construction Engineer. The writer was in direct charge of the planning investigations for the Wilbur and Watauga projects. All construction was done by the TVA's forces. All those mentioned are Members of ASCE.

What lies ahead in engineering education?

HENRY T. HEALD, M. ASCE, President, Illinois Institute of Technology, Chicago, Ill.

THERE MAY have been a time when our institutions of higher learning were permitted the luxury of going their own way, without too much regard to national crises or the changing patterns of national life. If there ever was such a time, it is long past. Since World War I, higher education in the United States has been deeply influenced by the changing courses of our economic, social, and political life.

The period immediately before and during World War II saw the beginning of major adjustments in educational policy to meet the special demands of full-scale war. During the late thirties and the early forties educators became acquainted with selective service, military training programs on the campus, special defense training programs for war industries, and sponsored research for direct military application. The end of the war brought a long and still-continuing relationship with another government agency, the Veterans Administration, which carries out the provisions of the G.I. Bill of Rights.

Manpower Policy Needed

About a year ago another drastic readjustment in our national way of life was made necessary by a limited immediate mobilization and the introduction of a long-term plan for strengthening the military forces. A systematic but flexible plan was required to meet the country's need for trained manpower to perform both military and civilian functions. The development of such a plan has been a matter of long discussion in Congress, in educational circles and in the various professions. Even now it is only beginning to take concrete form.

American universities have two essential functions: (1) They must educate the engineers, scientists, medical practitioners, and other leaders of tomorrow; and (2) they must serve as a continuing source of new ideas for the advancement of knowledge in all fields. Both these functions are essential to the welfare of the country in time of peace; they are even more essential in a time of national emergency.

If there were any positive assurance that the present emergency would be of short duration, a brief moratorium might reasonably be declared on the normal processes of education and fundamental research so that all our energies could be devoted to all-out war. But such an assurance is lacking. And any prolonged moratorium of this sort would result in a serious shortage of educated people in almost all fields, a shortage which could be only partially offset by a later high level of college enrollment.

Increased Demand for Engineers

Right now there is an unprecedented demand for trained men, one impossible to meet even if our colleges and universities continue to operate normally. The problem is made doubly difficult because, at the same time, a military force of three million or more must be created, and this force must be built up with young men who should be preparing now for occupations in engineering, science, and other essential fields.

Graduates from engineering colleges totaled nearly 53,000 in 1950, the largest number in any single year in our history, reflecting the large postwar enrollment of veterans. But what of the future? On the basis of the number of students now enrolled, and the demands of the military services, it is estimated that the total number of students graduating in 1954 may be as low as 12,000, a figure far below the normal output prior to World War II.

Of these, few will be available to industry because of commitments to military service as a result of the ROTC or deferment. However, it is probable that by 1954 a substantial number of engineering graduates of earlier years will be returning from military service and will be available for civilian employment. Even so, it is obvious that in 1952, 1953, and 1954 the supply of such graduates will be scarcely half the estimated minimum annual need of industry. Much of this shortage is due to the dissemination, a few years ago, of statements that engineering was becoming an overcrowded field. By now this impression has been at least partially counteracted by the effective work of engineering societies and the EJC Manpower Commission, but there is little evidence that freshman enrollment next fall will increase.

This critical shortage of scientific and engineering manpower presents a serious threat to the safety of the country. Aside from its civilian impact, it will impair our military effectiveness, which is dependent not only on our fighting forces and our ability to manufacture new weapons and equipment, but also on the research and development work which makes such things possible.

Several institutions have decided to accelerate their curricula, a serious mistake under present circumstances, I believe. The only good result, a temporary increase in the number of graduates, can be obtained only by sacrificing the quality of the education. In the long run, this method of meeting the difficulty will contribute neither to the national security nor to the peacetime welfare of the country. The time now allocated to undergraduate engineering education is hardly adequate to prepare for the responsibilities of the profession, and even higher standards are needed if the profession is to continue to advance. Telescoping curricula into three years or less can be justified only by total war.

Selective Service or Universal Military Service

Proponents of universal military service starting at age 18 argue that the present danger is such as to require every young man to spend two years in active military service, followed by a period of reserve status during which he will be available if needed. If adopted, such a plan would produce at least a two-year gap in the normal flow of college graduates.

Legislation passed by Congress on June 7, 1951, does not provide for universal military service, but does make provision for such action later. It lowers the draft age to $18\frac{1}{2}$ and makes the period of service two years. It also extends the deferment powers of Selective Service for men engaged in, or preparing for, essential occupa-

tions. Selective Service has wisely adopted a plan for the continued deferment of some students now in college, with preference to those of higher ability and demonstrated competence to do college work.

Widespread condemnation of this deferment plan is, in my opinion, largely unjustified. It results primarily from the mistaken notion that the deferment plan provides exemption from, rather than postponement of, military service. Perhaps the most violent opposition has been on the grounds that only rich men's sons can go to college, a belief far from the truth today when opportunities for higher education are so widely available. Then too, we are still clinging to the old view that the mere donning of a uniform places the wearer in grave physical danger. With the advent of the atomic bomb, residents of cities and workers in laboratories and industrial plants may be the first to suffer in an all-out war.

With the drop in engineering college enrollment and the continuing downward trend anticipated for several years, this year's high school graduates can enroll in college with the assurance that they will be able to complete one year before being called for military service. Those accepted for advance ROTC training in the Army, Air Force, or Navy can expect to graduate from college before being called for active military service. Some deferments may be available for some of the students who do good college work even if they are not enrolled for officer training. But irrespective of Congressional action on universal military service, the able-bodied high school graduate of today may look forward to two years of military service before, midway in, or after his college education.

Increased Military Research

An important phase of the present defense program is increased research for military purposes. Reportedly the Defense Department alone is spending a billion dollars a year to ensure that American military forces will be provided with the most advanced and effective means of attack and defense. Universities and technological institutions are being called on to supply brains and facilities for a substantial share of this vast research program. Organized, sponsored research for military purposes represents an important contribution which educational institutions can make to the national welfare, and it is fortunate indeed for the nation that they have the ability and facilities to carry it out successfully. But there is real danger that the pressures of short-term expediency may seriously curtail the long-term objectives of these institutions as centers of teaching and fundamental research.

Inflation a Hazard to Education

By no means the least of the problems confronting educational institutions today is that of finances. Educational costs have spiraled upward along with the nationwide inflationary trend. This applies no less to talent than to supplies, and talent is education's most prized commodity. A high standard of intellectual competence must be maintained in the staffs or our educational institutions.

Staff members are confronted with a dilemma today. They find their own living costs rising rapidly, and they see persons of comparable intellectual stature receiving considerably higher compensation in industry. In most cases they could themselves take advantage of the higher salaries offered in the research and development laboratories of industry and government. A superior teaching and research staff is the greatest asset of an educational institution, and such institutions can ill afford to let their staffs deteriorate into mediocrity.

More Cooperation with Industry Needed

Educational institutions are beset by financial difficulties arising out of higher costs, decreased enrollment, and declining support from outside. Their needs must be met either in the form of direct contributions from private citizens and corporations or in the form of taxes for publicly supported institutions. Many outside sources already are contributing generously, but more support is needed. In the case of privately supported institutions, this is the only method of retaining, developing, and improving the teaching and research skills which provide the graduates, the fundamental knowledge, and the applied research on which industry depends for its continued prosperity and security.

Although unrestricted gifts are badly needed, there are many other ways in which industry can assist privately supported education and at the same time help itself. It can encourage employees to enroll for part-time study to increase their on-the-job effectiveness. It can participate in cooperative programs in which students spend alternate periods in the classroom and in the plant. It can set up special in-plant programs on company time or after regular hours in cooperation with nearby educational institutions.

Then too, industry can provide benefits for educational institutions and receive benefits in return by establishing scholarships for undergraduates and fellowships for post-graduate students, and by hiring students during vacations. It can also sponsor research appropriate to the interests of the industry and the qualifications of the educational staff, both of a fundamental nature and of a more immediately applicable type.

In this time of crisis, engineering educators must not lose sight of their long-range objectives. A balance must be maintained between education and research, as the one strengthens the other and neither is desirable or adequate by itself.

Engineering education should continue to use every resource at its command in encouraging qualified young men and women to enroll in engineering and science courses. The flow of students into engineering colleges, no matter how restricted, must not be permitted to cease. The quality of engineering education must be maintained and improved. Only by careful screening and selection of students can the high standards of the profession be maintained.

While continuing the traditional broad course of professional education, educators should consider adopting, and where appropriate, should put into effect special training programs to meet urgent immediate needs when such programs can be superimposed upon regular activities. The demand for such programs may come from the government or from industry, or from both, and engineering education should be prepared to contribute its facilities and its staff when it can do the job.

Engineering institutions should make their maximum reasonable contribution to military research. By demonstrated performance they have shown that they are qualified to do this work.

Engineers and engineering educators should continue to encourage intelligent utilization of the critically short supply of trained manpower both by military and civilian agencies. What is needed most of all is the encouragement and assistance of the membership of the great professional societies. With the help of those who recognize its vital place in our national life, engineering education can continue to contribute its full share to industry, government, and the national security.

(This article is based on the address made by Dr. Heald, President of Illinois Institute of Technology, before the ASCE Summer Convention in Louisville, Ky.)

What are the prerogatives of professional employees under the Taft-Hartley Act?

THE STATEMENT below was prepared at the request of Engineers Joint Council by its Labor Legislation Panel. It is designed to be entirely factual with the sole object of presenting the courses of action open to professional employees under the provisions of the Taft-Hartley Act. It will be noted that no group of professional employees is required to engage in collective bargaining against the wishes of a majority of its members. Attention also is called to the fact that it is possible for professional employees to disengage themselves from an inappropriate union in which they previously may have been included against their wishes.

ASCE has taken no official position for or against unions formed exclusively by professional employees.

EVIDENCE accumulates that professional engineer employees in general are not sufficiently familiar with their privileges and prerogatives under the Taft-Hartley Act, which has been in effect since 1947. There are portions of Public Law 101, 80th Congress (Taft-Hartley Act), which are of particular significance to professional employees. Anyone desiring a copy may obtain it from his Senator or Congressman.

The law provides that a group of professional employees may determine, by majority vote, either (1) to form a collective bargaining unit composed solely of professional employees, (2) to delegate their collective bargaining rights to some other organization, or (3) to refrain from collective bargaining activity. Note that action hinges upon a *majority* vote of the professional employees concerned and that, once a course of action has been determined, all members of a group are governed by it.

Furthermore, professional employees who already are included in a unit which also contains non-professional employees, have the right to request withdrawal from such a group so that they may get out of an organization in which they are not properly represented and may decide upon one of the courses mentioned above. Again, such action must be by majority vote of the professional employees.

A considerable number of professional groups have been formed in different parts of the country. It is of particular interest to note that some professional employees, after years of embarrassment and grief under the old Wagner Act, have succeeded in getting out of labor unions which did not appropriately represent them and now have representatives of their own choosing.

The portions of the law which are of particular significance to professional employees follow.

In Sec. 2 (12), there is this definition:

> The term "professional employee" means (a) any employee engaged in work (i) predominantly intellectual and varied in character as opposed to routine mental, manual, mechanical, or physical work; (ii) involving the consistent exercise of discretion and judgment in its performance; (iii) of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time; (iv) requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study in an institution of higher learning or a hospital, as distinguished from a general academic education or from an apprenticeship or from training in the performance of routine mental, manual, or physical processes; or
>
> (b) any employee, who (i) has completed the courses of specialized intellectual instruction and study described in clause (iv) of paragraph (a), and (ii) is performing related work under the supervision of a professional person to qualify himself to become a professional employee as defined in paragraph (a).

Sec. 9 reads, in part, as follows:

> (a) Representatives designated or selected for the purposes of collective bargaining by the majority of the employees in a unit appropriate for such purposes, shall be the exclusive representatives of all the employees in such unit for the purposes of collective bargaining in respect to rates of pay, wages, hours of employment, or other conditions of employment: Provided, That any individual employee or a group of employees shall have the right at any time to present grievances to their employer and to have such grievances adjusted, without the intervention of the bargaining representative, as long as the adjustment is not inconsistent with the terms of a collective-bargaining contract or agreement then in effect: Provided further, That the bargaining representative has been given opportunity to be present at such adjustment.
>
> (b) The Board shall decide in each case whether, in order to assure to employees the fullest freedom in exercising the rights guaranteed by this Act, the unit appropriate for the purposes of collective bargaining shall be the employer unit, craft unit, plant unit, or subdivision thereof: Provided, That the Board shall not (1) decide that any unit is appropriate for such purposes if such unit includes both professional employees and employees who are not professional employees unless a majority of such professional employees vote for inclusion in such unit; . . . .

Sub-paragraph (a) is of interest to all. The quoted portion of sub-paragraph (b) is of particular importance to professional employees.

The foregoing is a simple statement of possible courses of action. Accomplishment of any one of the objectives mentioned may become far from simple.

If a group of professional employees becomes properly organized, petitions the employer to recognize it as the official representative for all professional employees affected, and the employer agrees, the situation may be established without complications and without necessity of certification by the National Labor Relations Board.

However, if on request of a majority of a group of professional employees, their employer declines to extend official recognition, or if some competing organization contests the right of the group to serve as the exclusive bargaining agent for the professional employees, further action is required in accordance with prescribed regulations.

To gain formal certification by the NLRB, a proper petition must be filed and hearings held to permit presentation of testimony for and against the petitioner. Numerous steps are involved and each must be taken properly. Final decision, of course, rests with the NLRB.

Because the various procedures required and the possible complications involved sometimes become rather complex, detailed elaboration in this brief statement is not warranted.

It is recommended that any group of professional employees in doubt as to a desired course of action consult with the nearest Regional Director of the National Labor Relations Board or address the Board directly at its office, Washington 25, D.C. Information so received, can do much to help in charting an effective course.

ENGINEERS' NOTEBOOK

Effect of eccentricity on steel columns cannot be safely ignored

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EFFECTS of eccentricity in applying loads to steel columns are quite often neglected in engineering practice. This is particularly true in the case of beam-to-column flange connections.

Of the many reasons given for the omission of eccentricity, two are prevalent. One is that the analysis for eccentricity is cumbersome and often difficult, thus not practicable in an engineering office. The second is that the maximum moments induced by eccentricity occur at the beam-to-column connections, whereas the dangerous buckling point for the column is midway between beams, where the moments due to eccentricity are a minimum. It is argued that, for the combined effect of axial loads and eccentric moments, larger allowable stresses should be used than those permitted by the column formulas.

A practical example is here given to show that the effect of eccentricity cannot safely be ignored, and that proper designing calls for larger column sizes than those required for vertical loads only. A graphical solution, based on the fixed-point method, is presented in Fig. 1. This is especially suited for quick analysis and is sufficiently accurate for design purposes.

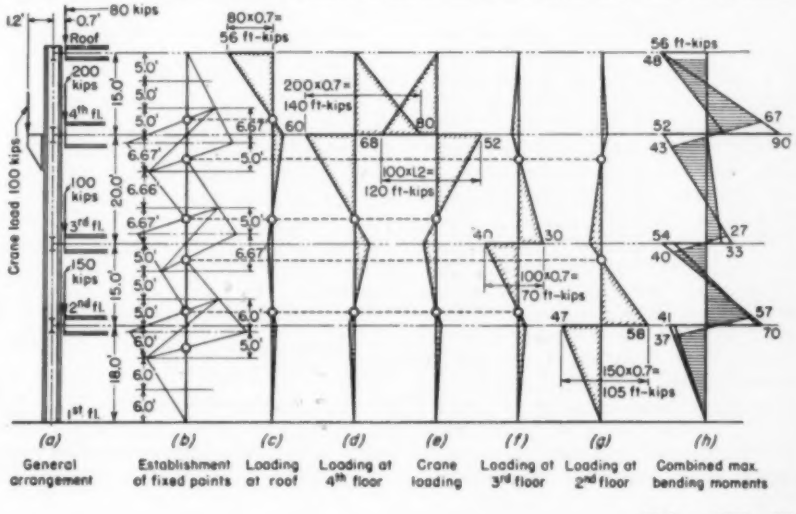
Importance of Eccentricity Illustrated

Four floor heights of 18 ft, 15 ft, 20 ft and 15 ft respectively, are each divided into three equal parts, Fig. 1 (*a*). At each floor level, these one-third parts are interchanged; the resulting location is shown by dashed-and-dotted lines, Fig. 1 (*b*). Starting from the bottom, an arbitrary line is drawn until it intersects the dashed-and-dotted line. From the intersection of this arbitrary line and the line indicating the second one-third division of the first span, a line is drawn through the intersection of the column and beam center-line until it reaches the first one-third division of the second span. Then a connecting line is drawn through this point and the intersection of the arbitrary line and the dashed-and-dotted line. Where this connecting line intersects the column line, there is the location of one of the "fixed points." It can be proved by trial that the arbitrary choice of the first line has no bearing on the location of the fixed point. Starting anew from this fixed point, the procedure is repeated until all the fixed points are established.

It is characteristic of these fixed points that they indicate the "fixity" of the members. Consequently, the true and final carryover of any moment, applied at any floor level, may be obtained by running a line from the moment through the fixed point to the next floor line, and then continuing the line through the subsequent fixed points in a zig-zag fashion.

The roof load of 80 kips produces a moment of $80 \times 0.7 = 56$ ft-kips. Applying this moment at roof level and running a continuous line through the fixed points, Fig. 1 (*c*), a complete moment diagram is obtained The fourth-floor load of 200 kips produces a moment of $200 \times 0.7 = 140$ ft-kips. This moment is to be divided into two parts, one above and one below the floor line, in the inverse ratio of column lengths. From the moments, continuous lines are drawn through the fixed points. This procedure is to be repeated for each loading at each floor line, as shown in Fig. 1 (*d*), (*e*), (*f*), and (*g*). The last diagram of Fig. 1, (*h*), shows the combined maximum moments, with and without the influence of the crane load of 100 kips. The shaded areas represent the moments on the clear spans, between the faces of the beams, which are to be used in the actual design of the structure.

FIG. 1. EXAMPLE ILLUSTRATES necessity of taking eccentricity into account in design of steel columns. See Tables I and II for required section with and without eccentricity effect.



The results of Tables I and II clearly indicate that the omission of bending stresses in columns due to eccentricity of applied loads results in a reduced safety factor. It is hoped that the graphical solution presented in this article will be of practical value to designers.

The following terms are used in the example:

- M = bending moment due to eccentricity as shown on Fig. 1(h), in ft-kips
- L = distance between floors, ft
- r = least radius of gyration
- F_a = axial unit stress that would be permitted if axial stress only existed
- F_b = bending unit stress that would be permitted if bending stress only existed
- f_a = actual axial unit stress, kips per sq in.
- f_b = actual bending unit stress, kips per sq in.
- f_s = maximum combined unit stress, kips per sq in.
- B_x = bending factor, see Manual of AISC, chapter on allowable loads on columns

$\frac{f_a}{F_a} + \frac{f_b}{F_b}$ should be less than unity

TABLE I. STEPS IN SELECTING A COLUMN, TAKING ECCENTRICITY INTO ACCOUNT

Location	Accum. vert. loads, kips	Section req'd, omitting bending stresses	$\frac{L}{r}$	F_a	Equiv. vert. load due to eccentric connections (see Fig. 1 for moments $M \times 12 \times B_x$ kips)	Total load, kips	Final section
4th fl. to roof	80	14 WF 43	95	12.62	162	242	14 WF 61
3rd fl. to 4th fl.	380	14 WF 87	65	14.95	95	475	14 WF 111
2nd fl. to 3rd fl.	480	14 WF 103	48	15.88	126	606	14 WF 136
1st fl. to 2nd fl.	630	14 WF 142	54	15.59	82	712	14 WF 158

TABLE II. STEPS IN INVESTIGATING A COLUMN, DESIGNED BY IGNORING ECCENTRICITY

Location		$f_a = \frac{P}{A}$	$f_b = \frac{M}{S}$	$f_s = f_a + f_b$	$\frac{f_a}{F_a} + \frac{f_b}{F_b}$
4th fl. to roof	at ends	6.33	12.82	19.15	$\frac{6.33}{12.62} + \frac{12.82}{20} = 1.14$
	midway	6.33	7.65	13.98	
3rd fl. to 4th fl.	at ends	14.90	3.74	18.64	$\frac{14.90}{14.95} + \frac{3.74}{20} = 1.19$
	midway	14.90	1.74	16.64	
2nd fl. to 3rd fl.	at ends	15.90	4.18	20.08	$\frac{15.90}{15.88} + \frac{4.18}{20} = 1.21$
	midway	15.90	1.10	17.00	
1st fl. to 2nd fl.	at ends	15.10	1.96	17.06	$\frac{15.10}{15.59} + \frac{1.96}{20} = 1.07$
	midway	15.10	1.17	16.27	

Nomograph provides method for comparison of weir formulas

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WITHOUT DOUBT, the most elementary device for measuring open channel flow is the rectangular, sharp-crested weir in which the end contractions are completely suppressed. For over a hundred years now, experimenters have more or less concentrated on this type of weir in an effort to arrive at a formula which might serve as a basis for the more complicated types. The general formula, however, seems to elude each successive investigation, so that in summing up the results, one finds almost as many separate and distinct formulas as there have been investigators. The difficulty dates back to 1844, when Weisbach first proposed to account for the velocity head in the approach channel. The variety of empirical formulas published since that time borders on the fantastic.

This article makes no attempt to evaluate the various formulas but rather affords an opportunity for their comparison. To the writer's knowledge, all previous attempts at comparing weir formulas have been limited either by insisting on a particular value of head or in some other manner.

The notation employed is:

- Q = rate of discharge
- L = length of weir
- P = height of weir
- H = head on weir
- $D = P + H$ = depth of approach
- $q = Q/L$

All units are expressed in the foot-second system, and the flowing agent is water. The discussion is confined to the five representative formulas given on Fig. 1. The formula of Fteley and Stearns (1883) is homologous to Francis'; that of Frese (1890), to Bazin's; etc.

Eqs. 1 through 4 may be written

$$q = f(H) + \phi(H)/D^2$$

even as Eq. 5 becomes

$$q = f(H) + \phi(H)/P$$

where f and ϕ represent functions of H only. Thus Eqs. 1 through 4 reduce to

$$q - f - \phi/D^2 = 0$$

which in determinant form becomes

$$\begin{vmatrix} q & 0 & 1 \\ -1/D^2 & 1 & 0 \\ f & \phi & 1 \end{vmatrix} = \begin{vmatrix} q & 0 & 1 \\ -1/D^2 & 1 & 1 \\ f/(\phi+1) & \phi/(\phi+1) & 1 \end{vmatrix} = 0 \quad \ldots\ldots (6)$$

while Eq. 5 reduces to

$$\begin{vmatrix} q & 0 & 1 \\ -1/P & 1 & 0 \\ f & \phi & 1 \end{vmatrix} = \begin{vmatrix} q & 0 & 1 \\ -1/P & 1 & 1 \\ f/(\phi+1) & \phi/(\phi+1) & 1 \end{vmatrix} = 0 \quad \ldots\ldots (7)$$

In both cases, the second form of the determinant is obtained from the first by adding the second column to the third and then dividing each row by the element in the third column.

It can be shown that the first two columns in the final determinant of Eq. 6 may be used as coordinates in constructing an equivalent nomograph. Thus

$$x_q = 0 \quad , \quad y_q = q$$
$$x_D = 1 \quad , \quad y_D = -1/D^2$$
$$x_H = \phi/(\phi+1) \, , \quad y_H = f/(\phi+1)$$

By the same token, the nomographic coordinates for Eq. 7 become

$$x_q = 0 \quad , \quad y_q = q$$
$$x_P = 1 \quad , \quad y_P = -1/P$$
$$x_H = \phi/(\phi+1) \, , \quad y_H = f/(\phi+1)$$

To facilitate the use of the foregoing data in actual construction, it becomes expedient to define a set of rectangular coordinates as follows:

$$x' = x, \qquad y' = x + y$$

whence

$$x'_q = 0 \, , \quad y'_q = q \ldots\ldots\ldots (8)$$
$$x'_D = 1 \, , \quad y'_D = 1 - 1/D^2 \ldots (9)$$
$$x'_P = 1 \, , \quad y'_P = 1 - 1/P \ldots (10)$$
$$x'_H = x_H \, , \quad y'_H = x_H + y_H \ldots (11)$$

where the required values of x_H and y_H are to be computed as indicated in Table I.

Based on Eqs. 8 through 11 and the data contained in Table I, Fig. 1 is then constructed. The maximum and minimum experimental values of H available in the derivation of each formula are indicated by the numbers which appear to each side of the name assigned to the corresponding H-scale. It may also be of interest to note that for $x' = y' = 0$, both Q and H are zero, while for $x' = y' = 1$, the quantities H, D, and P are all infinite.

For any combination of P and H values, straight lines on Fig. 1 afford a visual comparison of the five weir formulas under consideration. In fact, for Eqs. 1 through 4, the four straight lines must all pass through the same point on the D-scale; so that the steeper the line, the higher the value of q. To obtain the value of q for Eq. 5, the straight line must be fixed by a point on the P-scale, thereby precluding a direct comparison with the other four equations. Within its declared limits, however, the Rehbock formula is perhaps the most accurate weir formula yet devised, and is included in Fig. 1 as the closest available approximation to the absolute standard against which all other formulas should be checked.

TABLE I. DATA FOR FIG. 1

Formula	Functions			Coordinates	
	H	f	ϕ	x_H	y_H
Francis	...	$3.33H^{1.5}$	$0.866H^{2.5}$	$\phi/(\phi+1)$	$f/(\phi+1)$
Bazin	...	$(3.25H + 0.0789)H^{2.5}$	$(1.79H + 0.0434)H^{2.5}$	$\phi/(\phi+1)$	$f/(\phi+1)$
King	...	$3.34H^{1.47}$	$1.87H^{2.47}$	$\phi/(\phi+1)$	$f/(\phi+1)$
Swiss	$H + 0.0052$	$(3.29 + 0.0108/H_1)H^{1.5}$	$(1.64 + 0.0054/H_1)H^{2.5}$	$\phi/(\phi+1)$	$f/(\phi+1)$
Rehbock	$H + 0.0036$	$3.23H_1^{1.5}$	$0.435H_1^{2.5}$	$\phi/(\phi+1)$	$f/(\phi+1)$

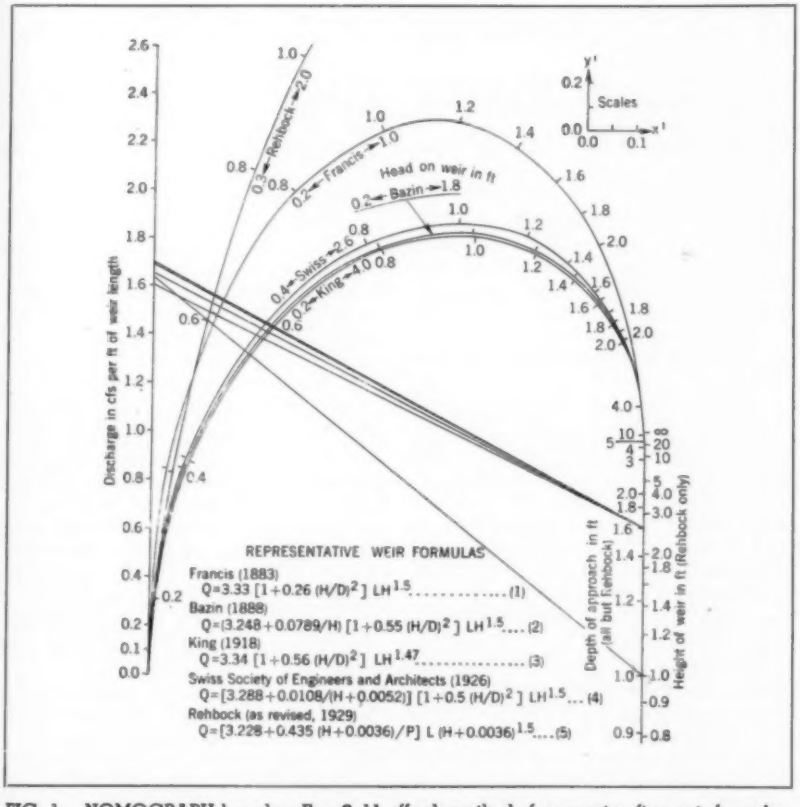
Discharge in cfs per ft of weir length
Head on weir in ft
Rehbock
Francis
Bazin
Swiss
King
Scales
REPRESENTATIVE WEIR FORMULAS
Francis (1883)
Q=3.33 [1+0.26 (H/D)²] LH^1.5 ..... (1)
Bazin (1888)
Q=(3.248+0.0789/H) [1+0.55 (H/D)²] LH^1.5 .... (2)
King (1918)
Q=3.34 [1+0.56 (H/D)²] LH^1.47 ..... (3)
Swiss Society of Engineers and Architects (1926)
Q=[3.288+0.0108/(H+0.0052)] [1+0.5 (H/D)²] LH^1.5 ... (4)
Rehbock (as revised, 1929)
Q=[3.228+0.435 (H+0.0036)/P] L (H+0.0036)^1.5 .... (5)
Depth of approach in ft (all but Rehbock)
Height of weir in ft (Rehbock only)

FIG. 1. NOMOGRAPH based on Eqs. 8–11 affords method of comparing five weir formulas. Within its declared limits, Rehbock formula is considered as closest available approximation to absolute standard against which all other formulas should be checked.

EXAMPLE

For $P = 1.0$ and $H = 0.6$, find $D = P + H = 1.0 + 0.6 = 1.6$

Then from the straight lines on Fig. 1:

Formula	q, in cfs per ft	Error, in Percent*
Francis	1.604	−2.02
Rehbock	1.637	0.00
Swiss	1.648	+0.67
Bazin	1.692	+3.36
King	1.700	+3.85

* Based on the assumption that the Rehbock formula is correct.

THE READERS WRITE

Excessive Leakage in the Brooklyn-Battery Tunnel

TO THE EDITOR: *The New York Times* on July 14 had an article by Joseph C. Ingraham in which he described the excessive leakage in the Brooklyn-Battery Tunnel and quoted the general manager of the Triborough Bridge and Tunnel Authority as stating that this was "one of the more 'screwy,' irritating and unexpected operations connected with tunnel maintenance," and also that "the men who designed and built this $80,000,000 facility were confident it would be a 'dry' tunnel for the most part."

Judging from the description, the leakage is indeed excessive and much greater than in any of the other vehicular tunnels in New York City. As the chief engineer of the New York City Tunnel Authority until October 1945, and therefore as the engineer responsible for designing the Brooklyn-Battery Tunnel, I felt and do feel confident that the tunnel, as designed, with the water-tightening as specified, would have been a dry tunnel *if the specifications had been adhered to.*

The writer has designed, built, operated and maintained many vehicular tunnels, among them the Holland Tunnel and the Queens Midtown Tunnel, and he has been either chief engineer or consulting engineer on all the cast-iron-lined vehicular tunnels built in the United States and one in Europe. He was responsible for the maintenance of the Holland Tunnel for the first three years of its operation and of the Queens Midtown Tunnel for five years.

The Queens Midtown Tunnel, the first vehicular tunnel to be built under the East River, is for the greater part of its length in soft heavy ground, but for intermittent short stretches it is in self-supporting rock, where a lighter cast-iron lining is used than in the soft heavy ground. In the maintenance of that tunnel, it developed that during the winter season when, owing to the lowered temperature, the cast-iron segments contract, those parts of the tunnel in rock showed some leakage, which was not the case in the parts of the tunnel in soft ground.

The customary method of making cast-iron tunnels watertight is to calk with metallic lead the joints between the segments from which the tube is built. In a vehicular tunnel used by the traveling public, sometimes in open automobiles, it is of the greatest importance that the tunnel be watertight so as not to annoy the public and also to preserve the interior finish and appearance. It was obvious to the writer, as chief engineer of the New York City Tunnel Authority, that on the Brooklyn-Battery Tunnel, which would have two-thirds of its length in rock and only one-third in soft ground, it would be necessary to develop methods of calking the joints between the segments in the rock with something in addition to the metallic lead. For the purpose of developing such a material, extensive research and laboratory tests and tests on full-size cast-iron segments were made.

From these tests and research a material was developed which met the requirements. It was specified in the printed construction contracts for the rock portion of the Brooklyn-Battery Tunnel, which were awarded in 1941, as follows: "The joints in the cast-iron lining of the tunnels shall be made watertight by continuous calking of asphalt-impregnated braided gasket and metallic lead placed in the calking recesses. . . ." At the time of the shutdown of construction work on account of the war, the excavation from the Manhattan side, which is in self-supporting rock, had advanced 2,800 ft in each tube, but the cast-iron lining had not been erected in that portion of the tunnel. The Brooklyn one-third of the tunnel is in soft ground and has no leakage.

When the Triborough Bridge Authority, now the Triborough Bridge and Tunnel Authority, took over jurisdiction of the Brooklyn-Battery Tunnel in 1945 and resumed construction work after the war shutdown, the new management, for some reason unknown to the writer, modified the construction contracts and eliminated the asphalt-impregnated braided gasket. Only the metallic lead for calking the joints was used. In my opinion this omission is the principal reason why the Brooklyn-Battery Tunnel shows excessive leakage.

Actual use of the Brooklyn-Battery Tunnel by traffic permits a check on another article which appeared in the public press. In the September 13, 1947, issue of *The New Yorker* the general manager of the Triborough Bridge and Tunnel Authority was given as the source of the statement that "the Brooklyn-Battery Tunnel was foredoomed to lose more money than any other tunnel of any kind in history."

On July 31, 1950, the *New York Times* quoted the same source as stating that from its opening day on May 25 to June 30, 1950, the tunnel had handled 1,373,383 vehicles and collected $490,335.42 in tolls, and that the new tunnel would "greatly improve the Authority's financial picture."

On May 12, 1951, the *New York World-Telegram and Sun* further quoted the Triborough Bridge and Tunnel Authority's general manager to the effect that during the first twelve months' period of operation of the Brooklyn-Battery Tunnel it handled 13,500,000 vehicles, that the gross revenue from tolls was $4,700,000, and that the operation and maintenance costs were $900,000, leaving a net revenue of $3,800,000.

At the time of financing the tunnel, the writer, as chief engineer of the New York City Tunnel Authority, on July 1, 1940, certified to the RFC, which financed the tunnel, that the estimated traffic in 1950 would be 12,400,000, and in 1951, 12,800,000—substantially less than what the actual traffic count proved to be. As may be seen, the original estimate was conservative and sound.

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Value of Actual Anchor-Bolt and Concrete Stresses

TO THE EDITOR: Mr. Hauer's comments in the July issue (p. 54) on my article, "Base Plates for Fixed-End Columns Should Be Designed to Resist Uplift" (April issue), are noted with interest. However, I feel that although the required anchor-bolt area is determined by the handbook method, a check on the design should be made to determine actual concrete and bolt stresses. These values are essential for proper design of the base details and determination of bond lengths for the bolts. The handbook also gives a series of charts prepared for investigation, but each solution entails the determination of values from three charts.

The method outlined in my article was intended to show that actual anchor-bolt and concrete stresses could and should be designed for on the basis of current theories. Also, I wish to point out that the method is valid only where the base plate and column are integrally connected. Where the column is only in bearing on the base plate, the design procedure to be followed is outlined in the *Procedure Handbook of Arc Welding Design and Practice.*

I would also like to call attention to the fact that in my article the reference to Eq. 6 in the title for Fig. 2 should be to Eqs. 1 and 3 (April 1951 issue, p. 46).

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SOCIETY NEWS

Engineers and Architects Join in Recommending Improved Procedures for Award of A-E Contracts

The procedure for the negotiation of Architect-Engineer contracts for defense construction is of prime importance to all members of the profession, whether in private practice, local, state or federal agencies and bears directly on the effectiveness of the nation's defense construction program. The possibility exists that the procedure favored by the military, if accepted, might cause damaging changes in long-established and proven customs for negotiation for professional services at all levels of government and in all private practice.

Because of the possible far-reaching effects of the proposed governmental procedures, the ASCE Committee on Private Engineering Practice has requested that the subject be presented fully to the entire membership of the Society. The Committee Report of April 2, 1951, follows, with a statement of developments subsequent to that date of concern to members.

Joint Report of Committee on Private Engineering Practice and ASCE Representatives on Joint Committee of the Design Professions

(Relating to Current Practice of Certain Federal Agencies in Awarding and Administering Contracts for Professional Engineering Services on Defense Construction Projects)

1. During the past few months the headquarters office of the Society has been made increasingly aware of general dissatisfaction regarding certain current federal practices concerning engineers. This dissatisfaction is expressed by many professional engineers who have had contacts with certain agencies of the federal government in connection with the awarding of contracts for engineering services on defense construction projects. It also is understood members of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Architects, also have voiced dissatisfaction with these practices. Through appropriate official action, the question was referred by ASCE to its standing Committee on Private Engineering Practice for investigation and report. This is the report of the Committee, and it presents the subject in some detail. The report is offered for the information of the Board of Direction and as a supporting document, if desired, for submission with any recommendation the Society may decide to present to the governmental authorities directly concerned with the problem.

2. The Committee has reviewed many of the complaints made by members of the Society. Members of the Committee also have discussed the subject informally with government officials who are in immediate charge of awarding engineering contracts. These discussions were for the purpose of obtaining direct and authoritative information.

3. There is lack of uniformity in the practices of certain governmental agencies in making awards for engineering services. It also appears that negotiations on the subject of fees have been conducted by some of the agencies in what seems to your Committee to be an arbitrary and unprofessional manner. The Committee also has learned that steps now are being taken by the Munitions Board to prescribe uniformity of practice in the Department of Defense.

4. The time-honored custom and practice of establishing fees for engineering services is covered fully in the July–October, 1949, report by this Committee entitled "A Method of Estimating Fees for Professional Civil Engineering Services" (CIVIL ENGINEERING, August 1949, page 49, and December 1949, page 53). Reasonable, average fees for projects up to $2,000,000 in costs are indicated by curves in the report. These show neither maximum nor minimum percentages, but are guide lines only. While the curves presented in this report do not extend beyond $2,000,000 in total cost, they may be used to establish fees for major components of work in projects for which total estimated cost is considerably in excess of $2,000,000. It is recognized that fees for some projects involving a substantial amount of repetitive design or the adaptation of standard plans should be lower than those shown in the "Interim Report," but the same general procedure and pattern outlined in that report can be followed.

5. The principal objections by civil engineers engaged in consulting and design work with respect to negotiation of fees are directed to current practices by many government negotiators. Certain agencies attempt to negotiate, and in some cases have negotiated, the amount of engineering fees by standards of their own devising. These standards vary widely from office to office and often depart radically from the established customs of the engineering profession.

6. So far as certain agencies are concerned, as shown by contracts already negotiated, there appears evidence of present and future difficulty which will do injury not only to individual engineers but to the engineering profession. Such injury will be inimical to the public interest and damaging to the defense program. Engineering firms have entered into contracts on the assumption that they would be dealt with fairly as professional people. Material financial losses are faced by some of these firms because of the fact that no provision has been made for an equitable adjustment of fees.

7. When the facts become generally known to engineers, it is the opinion of this Committee that there will be few engineer firms willing to risk financial losses inherent in the engineering contracts now offered. This would presage failure to get defense projects completed as soundly, economically and promptly as practicable. Economy and public interest are best served by employment of competent engineers adequately compensated for their professional services.

8. This Committee understands that the law controlling current defense projects is the Federal Property and Administrative Services Act of 1949. The Section of this law pertinent to engineering fees (section 304—*b*) reads in part as follows:

> ". . . a fee inclusive of the contractors costs and not in excess of 6 per centum of the estimated cost, exclusive of fees as determined by the agency head at the time of entering into the contract, of the project to which such fee is

applicable is authorized in contracts for architectural or engineering services relating to any public works or utility project."

9. The "contractor," named at the beginning of the above quotation refers to the engineer or architect who is party to the contract. The wording, "exclusive of fees as determined by the agency head at the time of entering into the contract," refers to legal, real estate agency and other fees including the engineering fee. If this phrase is considered parenthetically in the reading of this clause in the law, it is clear that the Congress intended to follow long-established custom and to authorize engineering and architectural fees to be based upon a percentage "of the estimated cost . . . of the project to which such fee is applicable."

10. In many cases the current practice for negotiating engineering fees by some defense agencies is to base the engineer's fee, not on a percentage "of the estimated cost of the project" but on the *estimated* cost to the engineer for doing the engineering work required, plus a profit not to exceed 10 percent of such estimated costs. District officers of these same agencies have been quoted by engineers as having advised that this new basis for fee negotiation is prescribed by law or by regulation equivalent to law.

11. Following a written request to the Corps of Engineers for the legal justification behind this new method for basing engineering fees, we were advised by the Corps of Engineers as follows:

"As indicated in your letter, there is no statutory provision limiting the profit to be paid to an architect-engineer under a contract for the production and delivery of designs, plans, drawings and specifications to 10 percent of the estimated cost to the architect-engineer of his performance thereunder. The Department of the Army, however, has administratively determined that no higher percentage of profit shall be paid under an architect-engineer contract. This office is bound by such policy."

It is the considered opinion of this Committee that this administrative determination is without valid grounds, is contrary to long-established practice in the profession, and is contrary to the intent of the law under which these projects are authorized and financed.

12. All of the contracts between the government and engineering concerns on defense projects are subject to renegotiation. The law so provides, as other laws also provided for similar contracts during World War II. We know of no engineering firms who object to such a provision, nor does this Committee oppose it. The renegotiation requirement provides adequate safeguard against excessive profits from defense work by any engineering firm. Such being the case, we have difficulty in understanding why this "administratively determined" radical departure from customary procedure has been adopted.

13. Since all contracts are subject to renegotiation after performance, the amount of estimated profit or loss which may accrue to the engineer on a particular project or the accounting procedures used by the engineer in estimating what he thinks his fee should be are properly the direct concern of the engineer rather than that of the government negotiator when the engineer's fee is first being negotiated. The amount of the fee which the engineer proposes is properly the direct concern of the negotiator, also that the fee proposed is "not in excess of 6 per centum of the estimated cost of the project." The methods used by a government contracting agency to reach its own conclusions as to the propriety of any fee proposed by an engineering firm are the business of government. It is deemed by this Committee to be improper and unprofessional for federal contracting officials to tabulate their opinion as to the amounts of the various costs which the engineer may meet in doing the job, to base the engineer's fee on such estimates and to force the engineer, as a condition of award of the job, to subscribe to the government's figures or to figures closely similar.

14. It is the opinion of this Committee that it is the proper concern of government to use every practicable means to assure that the best-qualified engineers available are engaged for each federal construction project. It is the concern of government to make certain that the designs and layouts produced by the engineers on any project meet the functional requirements of the project in a manner whereby the construction required can be accomplished on time and with the least expenditure of federal funds. It is the concern of government to make certain that no one makes an excessive profit through the performance of a government contract of any kind.

15. To these ends, application of provisions for maximum fees, renegotiation and other safeguards established by law are proper responsibilities of government. The detailed and itemized estimate made by an engineering firm as to what it thinks it will cost the firm to do the engineering work on a project is the engineer's responsibility and not that of the contracting agency. The engineer's books and records are open to government renegotiation boards as well as to the U. S. Income Tax Bureau. Engineering firms cannot retain excessive profits on federal projects even if they should collect them.

16. As to almost any engineering contract now in force with agencies of the Department of Defense, the principal "bone of contention" and the major source of financial loss to the engineer centers on the question of the *scope* of the project. It is here that many examples of injustice to the engineer are found. Of necessity, many defense projects are hastily conceived at the outset and it is not practicable for the government to describe every element with meticulous care. Nor is it always practicable for the government to estimate closely the probable cost of the construction of each element. It is obviously unfair, however, to require the engineer to take all the chances which result from failure by the government to describe definitely the scope of the work or from grossly inaccurate government estimates of project costs. A far more accurate delineation of the scope of each defense project than is usually made must be furnished if the government is to deal fairly with the engineering firms called upon to design these projects. In cases where this is impracticable, provision should be made to adjust an engineer's fee to fit the project with the estimate of construction costs as finally developed by final plans as approved by the government.

17. With a properly detailed description of the scope of a project and a proper breakdown of its several elements, the government and the engineer can make a reasonably accurate estimate of probable construction costs. This, in turn, makes possible a clear basis for fee negotiations between the engineer and the government. Deficient description of scope and correspondingly inaccurate estimates of cost now result in a determination of a fee which frequently bears little relation to final estimates of costs as they are developed during design of the project.

18. In many of the controversies which develop, the scope of the project has been increased materially but the engineer is held to his original fee. As an illustration of this feature, an engineer recently advised this Committee that he entered into a contract covering design and supervision of construction of a military base. The scope of the project was sketchily outlined on plans and further described briefly in writing. One element of the project was described as "Necessary Public Utilities," and this item was followed by the government's estimate for that part of the work in the amount of $200,000. This estimate was properly a factor in arriving at the fee for engineering on the project. When the project was finished the cost of the utilities proved to be about $2,000,000 instead of $200,000. The engineer, however, was not allowed any increase in his fee for designing $2,000,000 worth of utilities instead of the $200,000 worth described to him when his fee was negotiated. The government officials in this case are reported to have held that the consulting engineer agreed on a fee for designing the public utilities for the project, and it was his hard luck that they proved more extensive than the government had indicated in its estimate. It appears to this Committee that any such procedure is unfair. It exemplifies sharp practice at a level to which agencies of government, by law or regulation, should be forbidden to stoop.

19. A somewhat different type of example of failure on the part of the government properly to delineate the scope of work to be done by the engineer is illustrated by another project. In this case, as it was described to the Committee,

the fee was negotiated on what appeared to be an adequate description of the project and a reasonably accurate estimate of construction. Schematic standards were furnished as also was a topographic map of the project area. One of the first duties of the engineer was to make a project layout placing the buildings, locating roads, utilities and the like. This was done with the consultation and advice of the officer in immediate charge of the project. The layout was approved by the officer and sent to a higher level for concurrence. Higher level changed radically the original instructions and ordered the plans remade. This was done, but later higher authority decided to go back to the original idea and so directed the engineer. The sequence of events outlined above, in the opinion of this Committee, constitutes improper and unfair contract administration unless an equitable adjustment of the fee ensues.

20. These two examples cited do not represent isolated or infrequent cases. They appear to be typical of common practice. The frequent lack of proper delineation of the scope of defense projects and the scope of the work required of engineering firms employed on them demands correction as does the all too frequent occurrence of inadequate estimates by the government's engineers as to project costs. These serious defects in procedure on the part of some of the Services result in fees which prove inadequate when the facts are later developed. Renegotiation, however, works only in one direction—protection of the government against excessive profits. The engineer has no similar protection against deficiencies by government in faulty and misleading descriptions of scope of work to be done or from gross underestimates of project costs, the basic information the engineer must have in order to determine a proper fee.

21. In view of the present situation relating to current practice of certain federal agencies in awarding and administering contracts for professional engineering services on defense construction projects, the Committee on Private Engineering Practice of the American Society of Civil Engineers makes the following recommendations:

"*A*. That this report with its recommendations be brought immediately to the attention of the Executive Committee of ASCE.

"*B*. That the Executive Committee and the Board of Direction of the Society authorize and direct appropriate officials of the Society to bring this report to the attention of the chiefs of the federal Services directly concerned with design and construction of defense projects, to the Secretary of Defense, the respective Secretaries of Army, Navy and Air Force, and to the chairman of the Munitions Board.

"*C*. That all governmental units concerned be requested to promulgate regulations regarding private engineering firms engaged or to be engaged by the government on defense projects in accordance with the following listed general principles:

"1. That engineers and architects be recognized as professional men and that negotiations for fees for their services be conducted on a professional level.

"2. That calling bids for professional services or methods of negotiation leading to the same result, is unprofessional and should be specifically forbidden.

"3. That fees under fixed price contracts be lump sums negotiated on the basis of a percentage of the estimated project cost.

"4. That the fixed fee under cost-plus-fixed-fee contracts be actually a fixed fee as long as the scope of the work under the contract remains unchanged.

"5. That the scope of the work be carefully and sufficiently defined for each project so as to enable changes in scope to be determined. This should be understood to require an adequate description of all principal elements of a project with the government's estimate of cost for each, and a 'Total Estimate of Project Cost' so derived. Changes in scope of work should be prescribed as including unreasonably inaccurate preliminary estimates, changes in basic criteria and increases or decreases in number, size or extent of facilities. A percentage tolerance of, say, 15 or 20 percent up or down from the government's estimates, could be agreed upon during fee negotiations as determining the reasonableness of such estimates. A change of scope should be recognized as justification for a supplemental agreement providing an equitable adjustment of fee.

"6. That 'Letters of Intent' state definitely the work required thereunder and contain provision for periodic payments of engineering costs of work performed pending the negotiation of a contract. Should the project be cancelled after work has been performed under a 'Letter of Intent,' its terms should provide that an equitable fee shall be negotiated for the professional services furnished prior to such cancellation."

Respectfully submitted,
N. T. VEATCH, *Chairman*

April 2, 1951

AIA and NSPE Concur in ASCE Report

The April 2 report as above quoted was approved by the Board of Direction of the Society, and copies were transmitted to the American Institute of Architects and to the National Society of Professional Engineers. These organizations had previously declared interest in the subject and, like ASCE, had had informal discussions on it with military officials concerned. Both of these societies, through their governing bodies, declared complete concurrence in the ASCE Committee report, adopted the recommendations of the report, and so notified the chiefs of the three military engineer groups—Corps of Engineers, Army, Bureau of Yards and Docks, Navy, and Installations Section, Air Force—as well as the Secretaries of War, Navy, Air, and Defense.

The chiefs of the three military engineer groups were officially informed of the position taken by the engineers and architects on April 11 at a meeting in the office of the Chief of Engineers. At that time the subject was discussed in some detail by the military officials and the delegates of the professional societies present. The military group advised the civilian group that its recommendations would be considered carefully before new regulations on the subject were promulgated. The chairman of the April 11 meeting, the Assistant Chief of Engineers, advised the representatives of the design profession societies present that the three services had been directed to formulate regulations which could be made common to all three services covering methods of selection of engineers and architects and their permissible fees on defense projects.

The ASCE report of April 2 was critical of the procedures then used by the military relating to selection and fees on so-called architect-engineer (A-E) contracts. As the military services involved had indicated willingness to consider the recommendations made by the three design profession societies, ASCE did not publish its April 2 report pending decision by the military. The three design profession societies were advised in due course that such a decision had been reached. Representatives of the societies were invited to a meeting called for July 16, 1951, in the office of the Chief of Engineers for discussion of the subject.

On Friday, July 13, the headquarters office of ASCE received from its ASCE field office in Washington a copy of the proposed set of regulations. This document was dated July 10, 1951. It was in six parts, about ten typewritten pages, with Part IV missing. Representatives of the three design profession societies concerned, ASCE, AIA and NSPE, met separately in Washington, D.C., on Sunday July 15, to study the new document from the military engineer services. During the day, Part IV of the proposed regulations was made available. On the evening of July 15 the representatives of all three design groups met at the AIA headquarters.

The newly received document was discussed fully. The joint group reached a clear opinion that the regulations proposed did not differ in principle from the earlier procedures then and now in effect on many defense projects, on which the criticisms voiced in the ASCE report of April 2, as well as similar reports by AIA and NSPE, were based. By motions made and carried without dissent at this

joint meeting of about 30 delegates from the three organizations named, the following statement and recommendations were authorized.

Joint Statement and Recommendations by ASCE, AIA, and NSPE

Committees of the American Institute of Architects, the American Society of Civil Engineers, and the National Society of Professional Engineers representing upwards of 100,000 professional practitioners have separately and in joint session carefully considered the document relating to the selection and compensation of architectural and engineering firms, Parts 1 to 6, dated July 10, 1951, and unanimously took the following action:

"1. The American Institute of Architects, the American Society of Civil Engineers and the National Society of Professional Engineers are unalterably opposed to the subject document as being contrary to accepted principles of professional practice and as being against the public interest.

"2. The American Institute of Architects, the American Society of Civil Engineers, and the National Society of Professional Engineers reaffirm the following principles:

a. That engineers and architects be recognized as professional men and that negotiations for fees and for their services be conducted on a professional level.

b. That calling for bids for professional services or methods of negotiation leading to the same result be discontinued as unprofessional.

c. That fees under fixed-price contracts be lump sums negotiated on the basis of a percentage of the estimated project cost.

d. That the fixed fee under cost-plus-fixed fee contracts be actually a fixed fee as long as the scope of the work under the contract remains unchanged.

e. That the scope of the work be carefully and sufficiently defined for each project so as to enable changes in scope to be determined. This should be understood to require an adequate description of all principal elements of a project with the government's estimate of cost for each, and a 'Total Estimate of Project Costs' so derived. Changes in scope of work should be prescribed as including unreasonably inaccurate preliminary estimates, changes in basic criteria and increases or decreases in number, size or extent of facilities. A percentage of tolerance of, say, 15 or 20 percent up or down from the government's estimates, could be agreed upon during fee negotiations as determining the reasonableness for such estimates. A change in scope should be recognized as justification for a supplemental agreement providing an equitable adjustment of fee.

f. That 'Letters of Intent' state definitely the work required thereunder and contain provision for periodic payments of engineering costs of work performed pending the negotiation of a contract. Should the project be cancelled after work has been performed under a 'Letter of Intent,' its terms should provide that an equitable fee shall be negotiated for the professional services furnished prior to such cancellation.

"3. The American Institute of Architects, the American Society of Civil Engineers, and the National Society of Professional Engineers propose the creation of a commission composed of a representative from each of the three armed services, a representative from each society—the American Institute of Architects, the American Society of Civil Engineers, and the National Society of Professional Engineers—with a representative of the Munitions Board as chairman. The duties of the commission to be to formulate a procedure for the selection and compensation of architect-engineers.

"4. Pending the establishment of procedure by such commission, the American Institute of Architects, the American Society of Civil Engineers, and the National Society of Professional Engineers recommend that architect-engineer contracts be awarded in accordance with the practice followed by the Army and Navy during World War II, which related compensation to cost of construction.

July 16, 1951"

Joint Group Confers with Military Engineers

The above-quoted joint statement and recommendations were read by N. T. Veatch, chairman of the ASCE delegation, at the opening of the July 16 conference with the military engineers. Representatives of each of the society groups commented on present practices by the military relating to the subject, and each emphatically endorsed in one way or another the stand outlined in the ASCE Committee report of April 2 and the joint statement and recommendations of July 16, above quoted. Mr. Veatch requested the military engineers to give careful reconsideration to paragraphs 12 to 15 inclusive of this committee's April 2 report.

The conference resulted in a conviction on the part of most of the society representatives present that the top-side military engineers in charge of A-E contracts sincerely desire to handle these contracts along the lines recommended by the three design profession groups. The military members of the conference stated that the representatives of the civilian groups misunderstood the wording of the proposed regulations, regulations which apparently have been and are now in effect in large measure. Lack of understanding of these regulations was denied, and several engineers and architects cited examples from their own current experiences on defense work in support of their denials.

The conference was adjourned after about two and a half hours of friendly and free discussion. All present appeared to have but one objective, a determination of the best method by which the Department of Defense can obtain the best available engineering and architectural services on defense projects. It appeared conceded that high-quality professional services result in lowest project construction costs. It was clear that the military engineers and architects in charge hold to the same professional concepts concerning their work as do their civilian brethren. The representatives of AIA, NSPE and ASCE left the adjourned conference with every confidence that the necessary steps toward reaching an amicable conclusion on this complicated subject will be taken promptly by the military authorities.

The Executive Committee of Engineers Joint Council at its July 27 meeting considered the general problem as here presented. The EJC Committee expressed concurrence in the Joint Statement and Recommendations. Particular emphasis was given to proposal No. 3 of the Joint Statement recommending immediate creation of a seven-man commission representing the military, the engineers and architects, and the Munitions Board. All the principal national societies of engineers and the American Institute of Architects are now joined in opposing the procedures proposed by the military, and in urging adoption of a method by which those procedures could be modified in a manner truly in the national interest and satisfactory to the design profession.

ASCE was represented by its Committee on Private Engineering Practice assisted by other invited members. The ASCE group was headed by N. T. Veatch of Black & Veatch, Kansas City, Mo. The other ASCE delegates were:

Edmund Friedman, Maurice H. Connell & Associates, Inc., Miami, Fla.

Herbert C. Gee, consulting engineer, West Palm Beach, Fla.

Louis R. Howson, consulting engineer, Alvord, Burdick & Howson, Chicago, Ill.

Eugene L. Macdonald, consulting engineer, Parsons, Brinckerhoff, Hall & Macdonald, New York, N.Y.

John H. Morrison, Morrison-Maierle, Inc., Helena, Mont.

Enoch R. Needles, Howard, Needles, Tammen & Bergendoff, Kansas City, Mo., and New York, N.Y.

Carlton S. Proctor, Moran, Proctor, Freeman & Mueser, New York, N.Y.

Gustav J. Requardt, Whitman, Requardt & Associates, Baltimore, Md.

William N. Carey, Executive Secretary, ASCE, New York, N.Y.

Carl E. Beam, Assistant to the Secretary, ASCE New York, N.Y.

Joseph H. Ehlers, Field Representative, ASCE, Washington, D.C.

ASCE Cooperates in First Prestressed Concrete Conference

The Society is one of the sponsoring groups for a Conference on Prestressed Concrete, to be held at the Massachusetts Institute of Technology from August 14 to 16. Called to explore the importance of recent technical developments in prestressed concrete in the light of current material shortages and to consider potential applications, the conference will be the first of its kind ever held in this country. Other sponsoring organizations are the American Concrete Institute, the American Institute of Architects, the American Railway Engineering Association, the Associated General Contractors of America, and the Portland Cement Association. The program follows:

TUESDAY AUGUST, 14

MORNING

9:00 A.M. Registration

Welcoming Address—J. B. WILBUR, Head, Department of Civil and Sanitary Engineering, M.I.T.

1. Applications.

Why Prestressed Concrete?—L. H. CORNING, Manager, Structural and Railways Bureau, Portland Cement Association, Chicago, Ill.

Discussion—F. S. MERRITT, Associate Editor, *Engineering News-Record*, New York City

Tanks—CURZON DOBELL, Vice President, Preload Enterprises, Inc., New York City

Pipes—J. G. HENDRICKSON, American Concrete Pipe Association, Chicago, Ill.

Discussion—H. F. KENNISON, Chief Engineer, Lock Joint Pipe Co., East Orange, N.J.

AFTERNOON

Bridges (Survey of European Experience)—C. C. ZOLLMAN, Chief Design Engineer, Prestressed Concrete Corp., Kansas City, Mo.

Bridges (Survey of U. S. Experience)

S. S. BAXTER, Acting Chief Engineer, Bureau of Engineering Surveys and Zoning, Department of Public Works, Philadelphia, Pa.

R. H. BRYAN, Consulting Engineer, Nashville, Tenn.

C. L. JOHNSON, Consulting Engineer, Pontiac, Mich.

K. H. MIDDENDORF, Vice President and Chief Engineer, Prestressed Concrete Corp., Kansas City, Mo., and F. W. PANHORST, Bridge Engineer, State Division of Highways, Sacramento, Calif.

EVENING

Buildings—J. K. GANNETT, Vice-President and Director of Engineering and Research, The Austin Co., Cleveland, Ohio

Discussion—P. BELLUSCHI, Dean of Architecture and City Planning, M.I.T.

Discussion—N. THORSEN, Engineer, Freyssinet Co., Inc., New York City

Pavements

L. COFF, Consulting Engineer, New York City

B. F. FRIBERG, Vice-President, Granco Steel Products Co., Granite City, Ill.

WEDNESDAY, AUGUST 15

MORNING

Piles—A. E. CUMMINGS, Director of Research, Raymond Concrete Pile Co., New York City

Mass-Produced Units—K. P. BILLNER, President, Vacuum Concrete Corp., Philadelphia, Pa.

Discussion—D. O. MCCALL, Chief Engineer, Basalt Rock Company, Inc., Napa, Calif.

AFTERNOON

2. Materials:

Concrete—H. L. KENNEDY, Manager, Cement Division, Dewey and Almy Chemical Co., Cambridge, Mass.

Discussion—R. F. BLANKS, Chief, U. S. Bureau of Reclamation, Denver, Colo.

Wire—H. J. GODFREY, Assistant Chief Development Engineer, John A. Roebling's Sons Co., Trenton, N.J.

Discussion—W. J. ENEY, Head, Department of Civil Engineering, and A. C. LOEWER, Associate Professor of Civil Engineering, Lehigh University, Bethlehem, Pa.

Discussion—W. O. EVERLING, Director of Research, American Steel and Wire Co., Cleveland, Ohio

Bars—DONOVAN LEE, Consulting Engineer, London, England (Presented by CLIFF SCOTT, V. Nicholson Company, Inc., New York City)

Discussion—M. COHEN, Professor of Metallurgy, M.I.T.

THURSDAY, AUGUST 16

MORNING

3. Design and Research:

Design (General Considerations)—M. FORNEROD, Chief Engineer, Preload Enterprises, Inc., New York City

Discussion—W. E. DEAN, Engineer of Bridges, State Road Department, Tallahassee, Fla.

Design (Basic Concepts)—T. GERMUNDSSON, Structural and Railways Bureau, Portland Cement Association, Chicago, Ill.

Discussion—DEAN PEABODY, JR., Professor of Architecture, Harvard University, Cambridge, Mass.

Design (Continuous Spans)—G. H. PARIS and A. L. PARME, Portland Cement Association, Chicago, Ill.

AFTERNOON

Research (General Discussion)—C. P. SIESS, Department of Civil Engineering, University of Illinois, Urbana, Ill.

Reports on Specific Research Projects

A. R. ANDERSON, Consulting Engineer, Springdale, Conn.

B. J. BASKIN, Chief Engineer, Concrete Products Co. of America, Philadelphia, Pa.

B. BIRDSALL, Assistant Chief Engineer, Bridge Department, John A. Roebling's Sons Co., Trenton, N.J.

R. B. CREPPS, Director, Testing Division, Owens-Corning Fiberglas Corp., Newark, Ohio

H. J. HANSEN, Head, Structures Research Department, U. S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, Calif.

J. R. JANNEY, Assistant Development Engineer, Structural Development Section, Portland Cement Association, Chicago, Ill.

R. L. REID, Consulting Engineer, Houston, Tex.

E. J. RUBLE, Structural Engineer, Association of American Railroads, Chicago, Ill.

W. C. VOSS, Head, Department of Building Engineering and Construction, M. I. T.

Closing Summary—Rear Admiral J. F. Jelley, USN, Chief of the Bureau of Yards and Docks.

Boris Bakhmeteff, Honorary Member, Is Dead

Boris A. Bakhmeteff (1880–1951)

Members of the Society will be grieved to hear of the sudden death of Honorary Member Boris A. Bakhmeteff, hydraulic authority and noted civil engineering teacher, at his summer home at Brookfield, Conn., on July 21. He was 71.

In consulting practice in New York City since 1923, Dr. Bakhmeteff had been professor of civil engineering at Columbia University since 1931. He developed the university's research program in modern fluid mechanics and hydraulics, and recently was named honorary professor of civil engineering—the fourth person to receive this honor from Columbia. Author of several books and TRANSACTION papers, Dr. Bakhmeteff had been awarded the James Laurie Prize, the J C. Stevens Award and the Norman Medal.

Born in Tiflis, in the Caucasus area of Russia, he had been in the United States since 1917 and a citizen since 1935. He was educated at the Institute of Engineers of Ways of Communications at St. Petersburg, the Polytechnic Institute of St. Petersburg, and Zurich Polytechnic Institute, and taught for twelve years at the Institute Emperor Peter the Great in St. Petersburg. Sent to the United States in 1917 as undersecretary of state in the Ministry for Commerce and Industry of the Provisional Government, he continued in Washington as ambassador of the State of Russia until 1922.

A member of ASCE since 1917 and Honorary Member since 1945, Dr. Bakhmeteff had been active in and chairman of the Hydraulics Division.

Members Requested to Submit Yearbook Data

Members are reminded that September 30, 1951, will be the deadline for Yearbook changes in title or address. The cards mailed to members early in June should be filled out and returned if changes are needed. For the convenience of members who may have misplaced the cards mailed them, a duplicate form appears on page 88 of this issue.

Outstanding Technical Program and Field Trips Scheduled for Annual Convention

Plans for the ASCE Annual Convention—to be held in New York City, October 22–26—are being completed under a hard-working committee of Metropolitan Section members, headed by William S. LaLonde, Jr.

More than 30 Technical Division sessions will comprise one of the largest and most outstanding technical programs ever arranged by the Society, with all but one of the 14 Divisions participating. The Engineering Economics Division will inaugurate activities with an all-day program, including a luncheon sponsored by the Division. The Power, Construction, and Soil Mechanics Divisions are also planning luncheons, and there will be four meetings each of the Soil Mechanics and Hydraulics Divisions. A special general session, sponsored by the Civil-Military Liaison Committee, will bring Army, Navy, and Air Force chiefs to a panel discussion on relationships between the military and the engineering profession.

Joint Sessions on New Jersey Turnpike

Planning, finance, design, and construction of the New Jersey Turnpike, one of the most difficult and costly road-building projects ever undertaken, will be studied in a series of sessions. An inspection tour by bus over parts of the 118-mile superhighway, which is scheduled for completion in November, will supplement the technical sessions on the project.

Several other Divisions are also planning tours to points of engineering interest in the Metropolitan area, with the details to be announced in the September issue. Of wide general interest will be a harbor trip that will give an opportunity to view New York waterfront installations from ship board. The Port of New York Authority and the New York Central System are cooperating in this excursion.

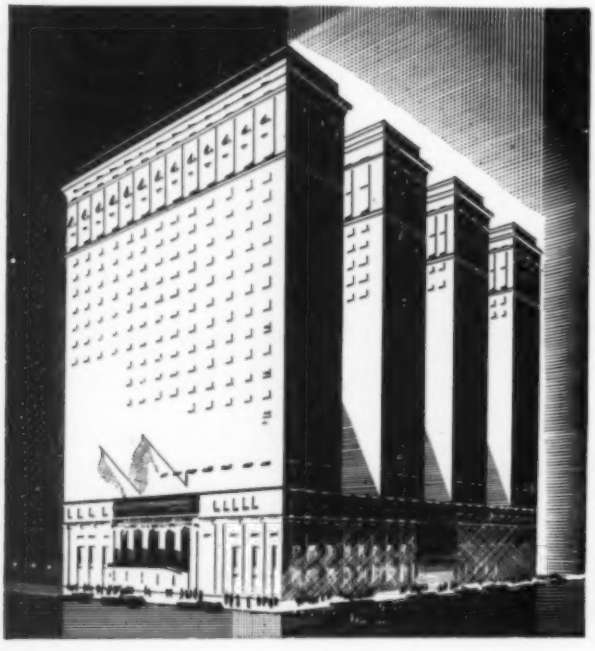
Wednesday Morning Meeting

Induction of a new slate of Society officers and award of prizes and honorary memberships will be highlights of the Wednesday morning program. The events of the week will also include Local Section and Student Chapter Conferences, the traditional reception and dinner dance, a smoker for the men, and special entertainment for the ladies.

Post-Convention Tour Planned

As announced in the July issue, the Annual Convention Committee is arranging another Bermuda cruise, with the added interest of a stop at Nassau. Leaving New York Harbor on October 27, aboard the *Queen of Bermuda*, the tour will return to New York on November 3. A luxury cruise-ship built especially for the Bermuda run, the *Queen* has been completely reconditioned for the pleasure excursion service. Its schedule has been arranged especially for the convenience of those attending the Annual Convention. The all-inclusive price for this tour, beginning at $197.35 includes all taxes.

To assure reservations, choice of staterooms must be made early. Full-information pamphlets are available on request from Leon V. Arnold, 36 Washington Square, West, New York 11, N.Y. Mr. Arnold is the travel consultant who has been in charge of similar ASCE post-convention cruises in past years.



DESIGNED AS a convention hotel, the Statler will provide the number and type of rooms needed to assure successful sessions of the Technical Divisions and the numerous social events planned.

Statler Will Be Headquarters Hotel

Members are reminded of the change in headquarters hotel as well as the change in the date of the Annual Convention from January to October. To accommodate the expanded New York Convention, the Statler—conveniently located on Seventh Avenue, just across the street from Pennsylvania Station—has been selected as meeting headquarters.

Program in the September Issue

The September issue will carry the full Convention program.

Board Elects Four to Honorary Membership

At its Louisville meeting the Board of Direction of the Society elected to honorary membership four engineers who are outstanding in their fields of specialization: Samuel A. Greeley, Charles G. Hyde, Jonathan Jones, and Frederick Ohrt.

An authority in the sanitary engineering field, Mr. Greeley is senior partner in the Chicago consulting firm of Greeley & Hansen. Since 1914 he has been in private practice in Chicago—as member of the successive firms of Pearse & Greeley, Pearse, Greeley & Hansen, and Greeley & Hansen.

Professor Hyde has combined teaching and consulting work in a highly successful career. Going to the University of California as assistant professor of sanitary engineering in 1905, he was full professor from 1909 until his retirement in 1944 with the rank of professor of sanitary engineering, emeritus. During his long career he has rendered engineering service to both the state and nation.

Jonathan Jones, chief engineer of fabricated steel construction for the Bethlehem Steel Co. since 1931, has had a long career of achievement with the Bethlehem Steel Co. and its predecessor organization, the McClintic-Marshall Co. He has contributed to many research and testing groups and is author of several papers in ASCE and other publications.

As manager and chief engineer of the Board of Water Supply of the City and County of Honolulu since 1929, Frederick Ohrt has initiated broad-scale research work and been responsible for the engineering of extensive ground-water development construction.

Honorary membership awards will be made in New York City on October 24 during the Annual Convention of ASCE.

New Head for ASCE Accounting Department

JOHN A. ZECCA BECOMES Chief Accountant and Head of Accounting Department at ASCE Headquarters, succeeding Walter Jensen who retired on June 1. Mr. Zecca has studied accounting at Heffley Business College and business administration at New York University. He has been employed in the Accounting Department of ASCE since 1931.

More Benefits Available to Insured Members

A letter from Smith and Sternau, Inc., administrators for the group disability insurance plan adopted by the Board of Direction two years ago, calls to the attention of the Executive Secretary increased benefits available to policyholders, as of the anniversary date of the contract, August 1, 1951.

The letter states that, "These broader benefits will naturally be available to all members who are now participating in the plan, as well as members who enroll in the future. The extended benefits will be as follows:

"1. *Disability Due to Illness:* The weekly indemnity will now be payable for two full years, rather than one year.

"2. *Partial Disability:* Partial disability arising from injuries will be increased from four to six weeks.

"3. *Indemnity for Specific Accidents:* One of the new features of the policy is a schedule of common injuries for which indemnity is guaranteed for a minimum number of weeks, even though the insured is not disabled that long. If the disability extends beyond this minimum guarantee, the weekly indemnity will be continued.

"4. *Waiver of Premium:* After a total disability has continued for six months while the policy is in force, the company will waive the payment of any subsequent premiums due and continue the insurance in force as long as the indemnity is payable and the insured member is continuously disabled.

"These extended benefits which we have been able to secure for your members are in addition to all other basic benefits under the original plan. They are made possible because of the enthusiastic reception of the plan by your members, which has meant favorable experience. We feel certain that this liberalization of coverage will result in a substantial increase in enrollment."

New certificates to members now insured, and notices to all other members, were sent out in July.

Tellers Canvass Ballot for 1952 ASCE Officers

July 2, 1951

To the Secretary

American Society of Civil Engineers:

The Tellers appointed to count the Ballots for Official Nominees report as follows:

For President—Carlton S. Proctor, nominated by the Nominating Committee of the Board of Direction.

For Vice-President—Zone I

(Term January 1952–October 1953)

George W. Burpee	271
Scattering	239
*Ineligible Candidate	82
Void	1
Blank	25
Total	618

For Vice-President—Zone IV

(Term January 1952–October 1953)

A M Rawn	828
Scattering	320
*Ineligible Candidate	51
Void	5
Blank	12
Total	1,216

For Director—District 1

(Term January 1952–October 1954)

Walter D. Binger	184
†James H. Griffin	25
Scattering	98
*Ineligible Candidate	64
Void	0
Blank	18
Total	389

For Director—District 2

(Term January 1952–October 1954)

Frank A. Marston	111
Scattering	59
*Ineligible Candidate	24
Void	1
Blank	2
Total	197

For Director—District 6

(Term January 1952—October 1954)

George Washington McAlpin	288
Scattering	49
*Ineligible Candidate	39
Void	0
Blank	0
Total	376

For Director—District 10

(Term January 1952–October 1954)

James A. Higgs	379
Scattering	31
*Ineligible Candidate	24
Void	0
Blank	1
Total	435

For Director—District 11

(Term January 1952—October 1954)

Isaac C. Steele	377
Scattering	168
*Ineligible Candidate	85
Void	2
Blank	34
Total	666

Total number of ballots counted	3,897
Ballot envelopes rejected Without signature	11

Respectfully submitted,
R. EDWARD KUHN, *Chairman*
ROBERT E. WHITE, *Acting Vice-Chairman*

Burr L. Chase, Jr.	Fred J. Levine
Arthur A. Collard	Charles D. Morissey
Henry Goldfinger	Frederick W. Ockert
Thomas K. A. Hendrick	Milton C. Shedd
Edward S. Jarosz	Alan L. Sielke

(*Tellers*)

* These votes were cast for incumbent officers who are presently ineligible for reelection in accordance with Section 9, Article VI, of the Constitution.
† Note that this candidate has withdrawn his name from the election ballot.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Controlled Materials Plan

The Controlled Materials Plan for construction is unfolding slowly. The regulations and necessary forms have been issued but apparently the ground rules for approving allotments are not complete. CMP for manufacturing had an early start over CMP for construction. This may create a somewhat chaotic condition during the last quarter of this year if defense orders mount to the predicted totals for that quarter. The fact is that as of today many claimant agencies do not know what their allowance of steel is for the fourth quarter. With the necessary lead-time for rolling and fabricating and the time necessary to process applications taken into consideration, it seems likely that many fourth-quarter deliveries of structural steel may not be made on schedule.

A self-certification system for private housing is to be established on the theory that Regulation X on real estate credit, together with some prohibitions on the use of certain steel and copper products, will keep the situation within bounds.

A complete revamping and liberalizing of the basic NPA order M-4 on construction is under way. The permit system will be subordinated.

Legislation Pending

Legislation referred to in last month's column is in status quo at the moment, except for major economic control measures which can be followed in the daily press. A request for $60 billion for military spending is under consideration and is likely to be trimmed.

Civil Defense Conference

A Federal Civil Defense Conference held in Washington was well organized and attended by interested groups from all over the nation, affording this program its first comprehensive countrywide get-together. Good organization work has been done in certain fields such as communications, fire and police protection.

Foreign Policy Conference

At the invitation of the State Department, the Field Representative attended a National Conference on U.S. Foreign Policy. Many aspects of this subject were fully discussed and considerable emphasis was placed on the Point IV program under the Department's Technical Cooperation Administration. The organization and procedure have been perfected in recent months and experts are being sent to many underdeveloped countries. One engineering reaction was that there seems to be excessive emphasis on agriculture rather than engineering in the program and excessive reliance on governmental bureaus as the source of expert personnel.

In connection with the drafting of CMP Form 4-C to be used in applying for materials under the new Controlled Materials Plan, the Field Representative sat as a member of a special committee of the Advisory Council on Federal Reports. The original four-page questionnaire form was reduced to two pages and considerably clarified.

NPA Regulations

NPA regulations and actions have been thoroughly discussed at several recent meetings, notably that of the Construction Mobilization Committee of the U.S. Chamber of Commerce, of which ASCE President-elect Carlton Proctor is vice-chairman. The proposed self-certification procedure for controlled materials, whereby a private residential builder can grant himself full priority allotments of materials up to a specified amount per house was discussed. Officials were requested to take steps to assure that builders of heavy engineering structures will not be deprived of scheduled deliveries of alloted materials because steel products have been self-allocated elsewhere. Assurance was given that the situation will be watched and also that prohibition against the use of certain steel products, including structural shapes, will be imposed on home builders.

ASCE MEMBERSHIP AS OF JULY 9, 1951

Members	7,896
Associate Members	10,169
Junior Members	14,395
Affiliates	68
Honorary Members	40
Fellows	1
Total	32,569
(July 9, 1950	29,162)

The matter of claimant agencies for construction materials was discussed. In general such agencies for construction materials was discussed. In general such agencies are government bureaus, expert in a special field, such as the Bureau of Public Roads on highway construction. Several fields of activity were placed in NPA as a catch-all rather than in agencies specializing in the field. Most important among these are sewer and water systems.

Building Codes Discussed

Several meetings of a committee recently organized under the auspices of the Construction and Civil Development Department of the U.S. Chamber of Commerce have dealt with some administrative and procedural aspects of building codes. Architects, manufacturers of building materials and equipment, general and specialized contractors were also in attendance. This committee will recommend procedures for expediting the adoption of new and the amendment of old building codes.

The technical details of building codes are being adequately handled by various joint committees in which ASCE participates, as well as by several government agencies. As noted elsewhere in this issue, the Building Research Advisory Board, in which ASCE has taken an active part, has a contract with the Defense Production Administration under which BRAB will conduct certain building research which should have important repercussions on building code provisions.

Corps of Engineers Conference

On July 16 an important conference called by the Corps of Engineers, was attended by prominent officers of the Corps, the Bureau of Yards and Docks, the Air Corps and about 30 representative of technical societies, including the entire Committee on Private Engineering Practice of ASCE. Details are given elsewhere in this issue.

Joint Committee of the Design Professions

The Joint Committee of the Design Professions has had several lengthy meetings drafting a detailed statement on the respective responsibilities of civil engineers, mechanical engineers, architects, landscape architects and city planners on large-scale housing projects and on other large developments involving joint responsibilities. This statement is designed to replace a former document on federal housing agreed to a decade ago by interested societies, including our own. A draft will in due course be presented to the several societies for approval or amendment.

Washington, D.C.
July 24, 1951

MID-SOUTH SECTION presents student awards at recent joint meeting with Juniors at Fayetteville, Ark. Here Ben W. Dees (left), Arkansas Contact Member for Section, presents Section's Award of Merit and cash prize of $20 to Alvin C. Singer, of University of Arkansas. Similarly honored were Frank D. Montague, Jr., of University of Mississippi, and Charles H. Filgo, of Mississippi State College.

Engineering Society Secretaries Meet

Numerous phases of engineering society operation were discussed at the fifteenth annual conference of the Council of Engineering Society Secretaries in Rochester, N.Y., June 22 and 23. The agenda included talks on guidance for high school students in selecting engineering courses, by Willis F. Thompson, chairman, Guidance Committee, ECPD; awards and student assistance, by Ernest Hartford, Executive Assistant Secretary, ASME; problems of meeting increased cost in society operation, by Charles S. Pearce, Secretary, American Ceramic Society; and Engineers Joint Council, by William N. Carey, Executive Secretary, ASCE. Of special significance was a paper on engineering manpower by Carey H. Brown, chairman, Manpower Commission, EJC, which emphasized the increasingly critical shortage of scientific and engineering personnel.

In the election of officers for the sixteenth conference next year William N. Carey was elected president, and Henry S. Harris, Director of the Engineers' Club of Philadelphia, vice-president. Ernest Hartford and Frank G. Horton were reelected secretary and treasurer.

Scheduled ASCE Conventions

ANNUAL CONVENTION
New York, N.Y., October 22–26

NEW ORLEANS CONVENTION
New Orleans, La., March 5–7, 1952

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Buffalo	June 19	43	Luncheon meeting featuring Robert E. Bald, assistant chief engineer in charge of civil engineering for Lock Joint Pipe Co., East Orange, N.J., as speaker.
Cleveland	May 25	...	Meeting sponsored by Case Institute of Technology Student Chapter. "Your Future in Engineering" was discussed by Harry B. Osborn, technical director of the Ohio Crankshaft Co. James Dunn received Section's Junior Membership award.
Colorado	June 13	77	Special meeting of Executive Committee of Section with election of Walter E. Blomgren, assistant chief engineer, Bureau of Reclamation, as vice-president of Section, succeeding August L. Ahlf, who has gone to Siam on ECA mission.
Georgia	May 11	...	Meeting sponsored by Georgia Institute of Technology Student Chapter. Blake R. Van Leer, president of Georgia Tech, addressed the group. Section Award was presented to William F. Siedel; the Snow Award to Ernest Clay; and the Ralph Peters Black Award to Mike Conner. Student speakers included Roy Pfaffman, who spoke on hydraulics; Bill Bradford, structures; Ben Adams, soil mechanics; Tom Linck, sanitation; and Lawrence Gray, graduate work. Section publication, *Civil Engineering in Georgia*, was issued for the first time in magazine form in May. Congratulations on your fine work!
Kansas City	June 16	118	Annual picnic at Lake Quivera.
Los Angeles	June 25	177	Annual field day at the Oakmont Country Club.
Metropolitan	May 16	...	Recently elected officers include President Maurice N. Quade, Vice-President Frank C. Mirgain, Secretary Alfred Hedefine, Treasurer Charles E. Trout, and directors Nomer Gray, Irving F. Ashworth, and Arthur J. Fox, Jr.
New Mexico	May 21	...	Meeting of Section's Executive Committee with appointment of L. E. Wheeler as acting secretary-treasurer, to fill unexpired term of Eugene Zwoyer.
Oklahoma	May 11	...	Joint spring meeting of Oklahoma Sections with Oklahoma University and Oklahoma A. & M. College Student Chapters participating. Speakers included D. P. Grosshans, vice-president of Tulsa Section; David B. Benham, president of Oklahoma Section; Morris M. Blair, professor of business administration and economics at University of Tulsa; Richard W. Denner, Oklahoma University Student Chapter member; Eugene Crane, Oklahoma A. & M. College Chapter member; Mendel Glickman, professor of architecture, Oklahoma University; ASCE Director Norman H. Moore; and Gerald B. Klein, Tulsa, Okla., attorney. Banquet in evening concluded program.
Philadelphia	June 18	...	June outing at Bala Golf Club.
Pittsburgh	June 15	26	Junior Members annual picnic.
	June 23	80	Inspection trip to Veterans Hospital, which is under construction at Leech Farm, Pittsburgh. R. C. Bauers, representing architect-engineers, and R. L. Senior, representing contractors, guided the tour.
Sacramento	June 12	78	Luncheon meeting with Jack Sylvester, engineer in bridge department of California State Division of Highways, speaking on prestressed concrete.
San Diego	May 22	44	Dinner meeting. Lewis C. Coxe, commander, CEC, USN, discussed "The Subsidence of Terminal Island."
San Francisco	June 19	...	Dinner meeting with Anthony J. Kennedy, legislative counsel for the California Legislative Council of Professional Engineers, the principal speaker.
Southern Idaho	June 30	...	Annual ladies' night banquet. A colored film on India was shown.

NEWS BRIEFS . . .

Operation of Central Valley Irrigation System Begins

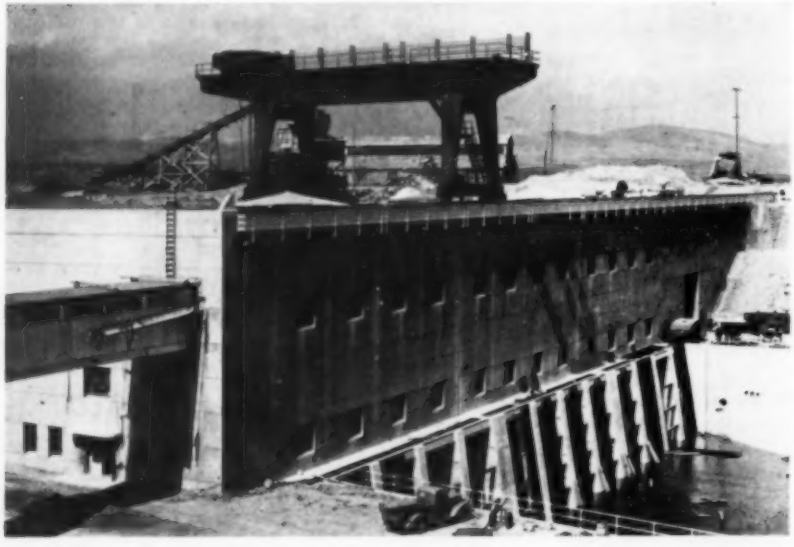
First, full integrated operation of the initial features of the Central Valley Project, on August 1, set off a ten-day celebration in California cities and communities that will benefit from the vast irrigation project. Signalizing completion of the first construction phase of the project, water was spilled from Shasta Dam into the Sacramento River to begin a ten-day journey through the complex network of canals constituting part of the project. Arrival of the water was observed with ceremonies in almost thirty cities and towns along its route, from Redding in the northern part of the state to Bakersfield in the south.

A project with the major objective of equalizing the water resources of the great central basin of the state by storing water at its northern end and transporting it to arid farm lands almost 500 miles to the south, the Central Valley Project consists of an integrated system of dams, power and pumping plants, and canals. It includes Shasta, Keswick, and Friant dams, the Tracy Pumping Plant, the Delta Cross Channel, the Delta-Mendota Canal, the Contra Costa Canal, the Friant-Kern Canal, and many associated projects.

Plans to solve the water problems of the area have been under discussion for almost sixty years. The solution of an integrated system of dams, canals, and other works was first suggested by Col. Robert B. Marshall, chief geographer for the U.S. Geological Survey, in 1891. His plan was made public in 1919 and placed before the California legislature in 1921. There followed the "State Water Plan" of 1931, forerunner of the Central Valley Project. After the plan had been approved by the state, federal funds for building it were obtained under the Emergency Relief Appropriation Act. Construction was begun by the Bureau of Reclamation in 1937 under the direction of Walker R. Young, M. ASCE.

Individual units of the Central Valley Project have been in operation since 1940, but until now the initial features have not been operated as an integrated system. The features just placed in operation cost an estimated $400,000,000, of which 87 percent will be repaid through sale of water and power developed over a sixty-year period. The remaining 13 percent is charged to non-reimbursable items such as flood control.

Two additions to the Central Valley Project have been authorized. One of these, the American River Development, is under construction. The other is the Sacramento River Canals System, which will provide irrigation for 200,000 acres in the upper Sacramento Valley.



PLACED IN OPERATION AS KEY UNIT in Central Valley Project on August 1 is this giant pumping plant at Tracy, Calif. Here six 22,500-hp pumps lift 2,000,000 gal of Sacramento River water per min a height of 200 ft into the Delta-Mendota Canal and thence into the arid San Joaquin Valley.

Surveyors and Mappers Meet in Washington

Surveys and maps as the basic blueprints for peace and development constituted the theme of the eleventh annual meeting of the American Congress on Surveying and Mapping, which was held recently in Washington, D.C. Hosts to the three-day meeting, which was attended by 1,000 surveying and mapping experts from the United States, Canada, and Latin-America, were Washington members of the Congress who are engaged in professional activities with the U.S. Geological Survey, the Army Map Service, and other government agencies. Alfred C. Stiefel, Assoc. M. ASCE, of the U.S. Geological Survey, was general meeting chairman.

The program included a talk by Gerald FitzGerald, Assoc. M. ASCE, president of the Congress and Chief of the Topographic Division of the Geological Survey, and a panel discussion by past-presidents of the Congress on the "Duties and Obligations of the ACSM to its Members and the Profession." Other speakers discussed the role of surveying and mapping in developing the economy of nations.

Formation of a new technical division on education under the leadership of Russell C. Brinker, Assoc. M. ASCE, professor of civil engineering at Virginia Polytechnic Institute, was a meeting highlight. One of the objectives of the new division will be to broaden and modernize courses in surveying, mapping, and related subjects offered by colleges and universities.

Another special feature of the meeting was the first showing in the United States of a large exhibit of maps and charts prepared by the principal government mapping agencies for display at the Fifth General Assembly of the Pan-American Institute on Geography and History held at Santiago, Chile, in October 1950.

Contract Let for Work on Bay St. Louis Bridge

Award of a $6,061,433 low-bid contract to Merritt-Chapman & Scott Corp. for construction of a four-lane bridge across Bay St. Louis is announced by the Mississippi State Highway Commission. The trestle-type structure, 10,198 ft long, will span Bay St. Louis near its mouth on the Gulf of Mexico to carry U.S. Highway 90 between the towns of Bay St. Louis on the west and Henderson Point on the east. It will feature a 124-ft bascule span at the channel point, providing 100-ft horizontal clearance.

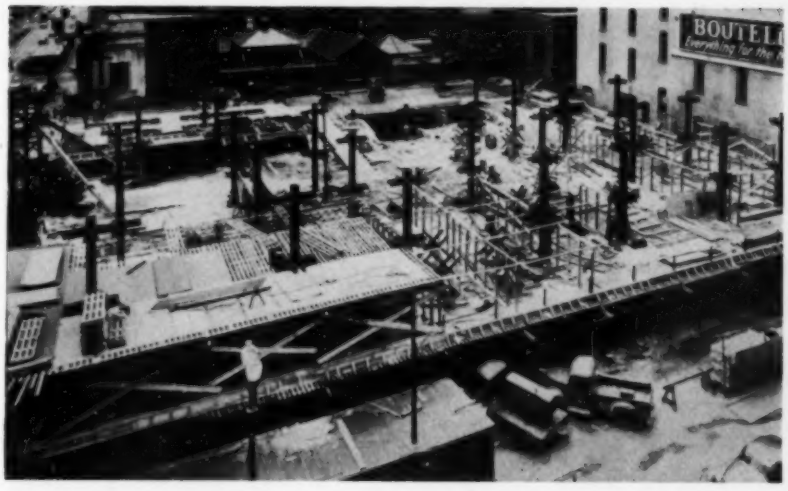
Bid Calls on Large Western Projects to Be Announced

Invitations to bid on several large Western construction projects will soon be issued by the Bureau of Reclamation. Listed in the Bureau's *Advance Construction Bulletin* for July 2, the jobs include tunnel construction on the Cachuma Project near Santa Barbara, Calif. The work will consist of construction of Sheffield Tunnel (6,000 ft long, 6 ft in dia, concrete-lined, horseshoe-shaped), part of the Carpinteria section of the South Coast conduit. Time allowed for completion is 450 days.

Another project will consist of construction of 15.5 miles of unlined Potholes East Canal (1,800-cfs capacity) and 5 miles of unlined Ringold Wasteway southeast of Othello, Wash. Part of the Columbia Basin Project, the structures are to include Scooteney Reservoir headworks, a check drop and stilling pool, check, wasteway and lateral turnouts, an 1,800-ft-long chute, eight drain inlets, and seven bridges. Time allowed for completion will be 725 days. Bids will also be asked on construction of the Babcock Pumping plant, part of the Columbia Basin Project, near Quincy, Wash. Working time will be 750 days.

On the Colorado-Big Thompson Project, bid calls will be issued for construction of Rattlesnake Dam in Rattlesnake Park, near Loveland, Colo. This is to be an earth-fill structure, 415 ft long and 115 ft high from bottom of cut-off trench to crest. Work will include a concrete spillway with uncontrolled crest and footbridge, outlet works, and a 245-ft, 16-in.-dia, concrete-lined, cast-iron pipe outlet encased in concrete. The time allowance is 400 days.

Minneapolis Initiates Parking Garage Program



AS A SOLUTION TO SERIOUS PARKING PROBLEM IN DOWNTOWN MINNEAPOLIS, group of property owners and businessmen organized under name of Downtown Auto Park, Inc., is building two parking garages at cost of $4,000,000. One six-level structure, with 520-car capacity, was recently completed. Start of second unit—seven-level structure with facilities for 835 cars—is shown here. Scheduled completion date is September 1. Project utilizes Smooth Ceilings System of construction, which eliminates need for column capitals, beams, drop panels and bearing panels along exterior walls, with consequent saving in form building, material and finishing costs. Design was handled by Detroit consulting firm of D. L. Briegel and Associates and Larson & McLaren, Minneapolis architects. Builders are H. N. Leighton Co. and Kraus-Anderson, Inc., both of Minneapolis.

Construction in First Half of 1951 Reaches New High

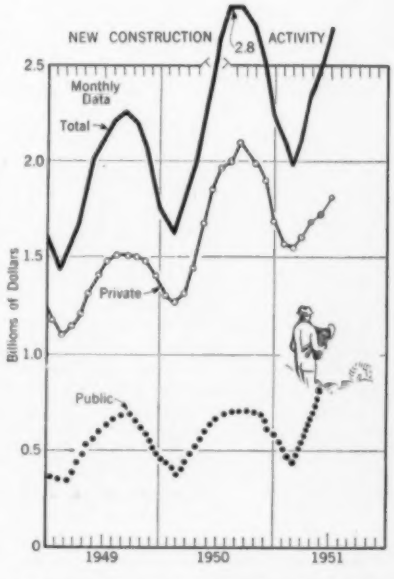
Total construction expenditures for the first six months of 1951, reaching almost $14 billion, were 16 percent above outlays for the same period in 1950, according to preliminary joint estimates of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the Department of Commerce. Despite marked increases in costs, the construction gains made during the period represented a larger physical volume of construction than in 1950 and exceeded all previous records for the period.

The defense program with accompanying restrictions on construction is reflected in the changing pattern of expenditures for the period when compared with the first six months of 1950, the joint agencies point out. The increase over the first half of 1950 is attributed largely to a rise of $740 million in industrial construction, about $270 million in military and naval facilities, and about $240 million in commercial construction. Residential building, which was first affected by control measures, was at the same level in dollar terms during both periods. Because of higher building costs, however, it was lower in physical volume.

Expenditures for new construction in June totaled $2,700 million, an increase of 6 percent over May, the joint agencies report. With the exception of commercial building, which was beginning to reflect the effects of construction controls, almost all types of construction expenditures increased over May. The relative gain in private residential construction, however, was considerably less than during the comparable month in previous postwar years.

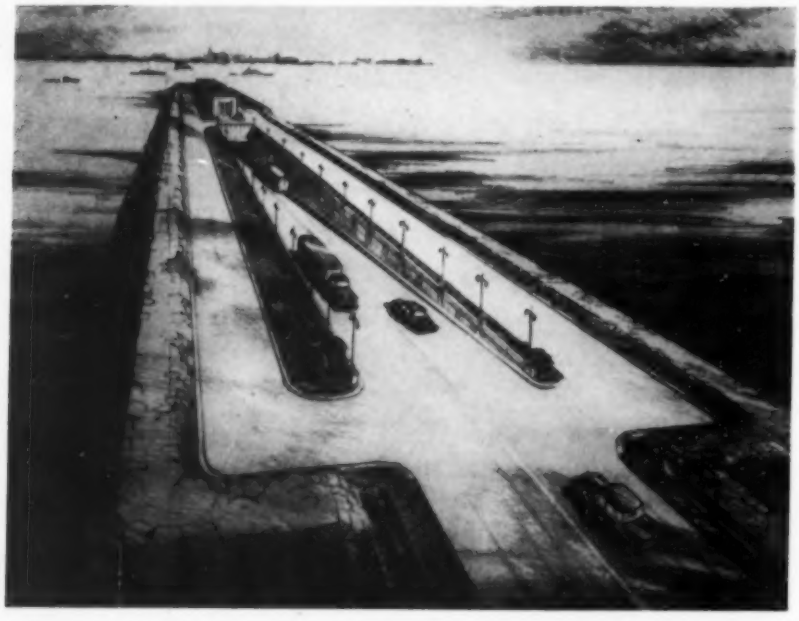
Seasonal expansion in highway construction accounted for a large part of the $50 million increase over the month in public construction. The dollar volume of expenditures for military and naval facilities, not yet fully under way under the defense program, rose only slightly over May.

Although expenditures for private residential construction remained at high level during the month, they decreased 23 percent from June 1950. This decline in homebuilding largely accounts for a decrease of 4 percent in total private construction expenditures as compared with a year ago. Private industrial, commercial, and public utility construction, although significantly higher than in June last year, did not offset the decline in residential building.



CONSTRUCTION ACTIVITY DURING JUNE rises 6 percent above May total, as shown in Department of Commerce curves. Gain is reflected in almost all types of construction expenditure with exception of commercial building.

Four-Mile Bridge-Tunnel to Span Hampton Roads, Virginia



PROPOSED $42,000,000 BRIDGE-TUNNEL, to be built by Virginia Highway Department across four-mile Hampton Roads water barrier separating the Norfolk and Newport News areas, is shown here in artist's rendering. Located approximately midway between two ferries now serving the area, projected crossing consists of combination causeway-bridge-tunnel with a viaduct over the Naval Operating Base at Norfolk. The tunnel is under the main channel and will be approximately 7,200 ft long between portals. The connection between the north portal of the tunnel and the north shore line consists of a combination causeway and low-level bridge 6,500 ft long. Artificial islands at each tunnel portal will contain ventilator buildings and equipment. Consulting engineers on preliminary phases of work are Howard, Needles, Tammen & Bergendoff and Singstad & Baillie. Actual construction of project is dependent on Army and Navy approval of design and location, and on further traffic and engineering studies.

Safety Conference Challenges Nation to Cut Highway Deaths

Highway accidents strike directly at our national strength "at a time when the urgent need is to make our country stronger," President Truman said at the opening session of the President's Highway Safety Conference in Washington, which was attended by 2,000. "The defense effort depends upon the efficient movement of goods and people over public roadways," he declared. "Highway transportation, like railway transportation, is indispensable to production on our farms and in our factories, and to every phase of the nation's work. Traffic accidents slow down production and weaken our whole economy."

The first challenge facing the nation, the President said, is to improve our highway system, "much of which, due to depression and war, is worn out and obsolete. The replacement program has not kept pace. Good roads are essential, and we must not make the mistake of thinking that highways are expendable in the emergency period."

As a further step in cutting highway deaths, the President urged that every high school student be given driver education and training. In conclusion he appealed to each individual to accept "personal responsibility to support the highway safety program."

Problems confronting engineers in carrying out their part of the Action Program were explored during a panel session of the Engineering Committee. These problems, made increasingly serious by the defense effort, are manpower and material shortages, rising costs, and the increased demands of road users. Fact-finding studies for long-range planning were seen as important not only for determining needs but also for enlisting public support. Virginia was cited as a state where highway planning is being adapted to the defense effort. An engineering study being made there places principal emphasis on maintenance of serviceability of a limited number of major highways. Tribute was paid in the committee's report to the automotive industry and the Society of Automotive Engineers for studies aimed at conserving scarce materials.

In the final session, the Conference declared that adoption of the Action Program by all states and cities "would result in reducing the death rate from its present level of 7.5 per hundred million vehicle miles of travel to 5 or less within the next year." In 1945, the year before the Conference was organized, the rate was 11.3.

Conference chairman was Maj. Gen. Philip B. Fleming, M. ASCE.

Changes in Tax Laws Recommended by AGC

Three changes in existing and proposed tax laws were suggested by the Associated General Contractors of America before the Senate Finance Committee on July 16, in the interest of eliminating "undue hardship on the general contractor."

The AGC prefaced its recommendations for consideration in connection with proposed tax legislation with an explanation that, "The operations of the general contractor are unlike the operations of members of any other industry in the nation. The general contractor has no inventory, depending entirely on skill and ingenuity and the various types of construction equipment to produce a profit. The general contractor's equipment must be used in all kinds of weather and under varied conditions. It is not protected from the elements and when in operation cannot be completely maintained. In this respect it differs very materially from industries where the machinery and equipment are well housed and completely maintained."

The following tax-law changes are requested.

"1. To permit a contractor to treat as a net operating loss, subject to the carry-back and carry-over provisions of Section 122 (*b*) of the Internal Revenue Code, an amount representing the excess of the replacement cost of equipment used in the trade or business over the original cost of the same type of equipment actually replaced in the year it becomes fully depreciated, or prior thereto.

"2. To permit a general contractor a carry-back and carry-forward of all unused depreciation allowances on equipment.

"3. That Section 3475 of the Internal Revenue Code with reference to transportation of property tax be amended as follows: 'The tax imposed under this section shall not apply to the use of motor vehicles by contractors in the movement of earth, rock, or other excavated material within the boundaries of or incidental to a construction project.'"

BRAB to Advise Government on Building Conservation

The Building Research Advisory Board has been selected as an independent research agency to advise the Defense Production Administration on conservation in building construction.

Under the terms of a recent one-year contract signed by the government and the National Academy of Sciences, sponsoring organization for the BRAB, the research agency will make a study of existing technical practices, standards, and regulations which provide reliable criteria for the evaluation of conservation measures in building design and construction. A second phase of the BRAB study will be concerned with review practices in federal building construction, including military construction. This part of the study will be directed especially toward identifying conservation measures practiced by government agencies engaged in construction and in determining differences in the standards of the various agencies.

The reports and recommendations made by BRAB will be used by the Construction Division of DPA as a basis for establishing conservation policies as required by defense mobilization. The over-all purpose of the study is to provide for the construction of as many buildings as possible within the limits of materials available.

Diversified Technical Program Features ASTM Annual Meeting

Various aspects of engineering materials were covered in 23 technical sessions and 615 technical committee meetings featuring the recent 54th annual meeting of the American Society for Testing Materials. During the week-long program, held in Atlantic City, N.J., under sponsorship of the Philadelphia District Council of the ASTM, 57 new specifications and tests were approved, and revisions in more than 200 existing tentatives and standards were acted on. A group in Committee B-2 on Non-Ferrous Metals and Alloys has been assigned responsibility for work on titanium.

Subjects studied in the technical symposiums included consolidation testing of soils, surface and subsurface reconnaissance, sandwich construction, and acoustical materials. Frank L. LaQue, in charge of the Corrosion Engineering Section of the International Nickel Co., New York, presented an outstanding Edgar Marburg Lecture on the subject of corrosion testing. Many of the technical papers were preprinted, and it is expected the symposiums will be issued as special technical publications later in the year.

Conservation of resources was held of major importance in the preservation and further development of our way of life in a talk by retiring President L. J. Markwardt, M. ASCE, assistant director of the U.S. Forest Products Laboratory. In this connection, he said, "many ASTM standards have contributed materially to better utilization of our materials." He stated that the principle, "What our forefathers have bequeathed to us, we must earn to possess," was applicable to ASTM and stressed the need for continuing research activity.

Five long-time ASTM members were awarded honorary membership in the organization for "especially meritorious service to it" and "outstanding eminence in the field of engineering materials." These included ASCE members A. T. Goldbeck, engineering director of the National Crushed Stone Association, Inc., Washington, D.C., and the late Frank E. Richart, research professor of engineering materials at the University of Illinois.

Truman S. Fuller, engineer in charge of works laboratory for the General Electric Co., succeeds Mr. Markwardt as president for 1951–1952, and L. C. Beard, Jr., is new vice-president.

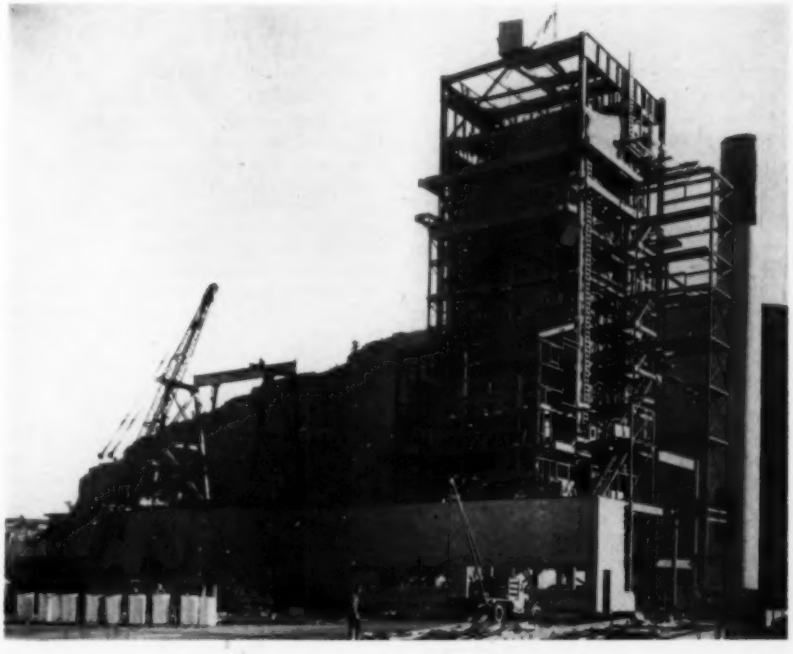
The 50th anniversary meeting of ASTM will be held in New York, June 23 to 27, 1952.

Forebay Bridge and Highway Across Davis Dam Is Open

Recent opening of the new forebay bridge and highway across Davis Dam is announced by E. A. Moritz, M. ASCE, director of the Bureau of Reclamation's Region 3. Forming the second highway crossing of the Colorado River in the reaches constituting the boundary between Nevada and Arizona, the new roadway across Davis Dam is the first to be built in connection with a Bureau of Reclamation dam under the terms of Public Law 562, approved in July 1946. The project was constructed under a four-party agreement among the states of Nevada and Arizona and two federal agencies—the Bureau of Reclamation and the Public Roads Administration.

The roadway follows the 1,600-ft crest of the earth- and rock-fill embankment and crosses a 542-ft bridge over the forebay and spillway channel at the Arizona end of the dam. The bridge consists of two steel plate-girder spans, each 210 ft long, and concrete approaches 60 ft long at each end

Montana Steam Station Utilizes Semi-Outdoor Construction



READY TO GO INTO SERVICE, Frank Bird Steam-Electric Station of the Montana Power Co., at Billings, Mont., will be first major steam station on system, which is now served by hydroelectric plants. Design of plant utilizes semi-outdoor construction, unique for temperature range of −40 to +100 deg F. Turbine generator is 60/66-mw AIEE-ASME Preferred Standard, mounted on outdoor deck, with enclosures at high-pressure steam end and at exciter only. Station is laid out for oil and natural-gas fuel, with provision for possible future use of coal. Unit-type design is employed, the single boiler being rated at 675,000 lb of steam per hr. Yellowstone River provides low-temperature condensing water. Design and construction are handled for the Montana Power Co. by Ebasco Services Inc.

Versatile Unit Speeds Bedloe Island Improvement

NEW DEVELOPMENT PROGRAM on Bedloe's Island in New York Harbor, site of world-famous Statue of Liberty, is expedited by use of Lorain 50-I crane, owned by New York contractor Allen N. Spooner. Unit is shown here with 50-ft boom placing granite blocks. Versatile material-handling machine, crane is also used for setting steel and pouring concrete and as clamshell for excavation. Construction program calls for new pier, walls, buildings and landscaping to improve facilities at this much-visited national park. Photo courtesy of the Thew Shovel Co.

Terminal to Consolidate Manhattan Air Facilities

Construction of a $5,500,000 airline terminal and public parking garage adjacent to the Manhattan approach to the Queens-Midtown Tunnel will start at once with signing of construction contracts, according to the Triborough Bridge and Tunnel Authority. The major contractor for the story and half structure, described by the Authority as "the most modern and functional facility of its kind in the world," will be S. S. Silberblatt, Inc., of New York.

Consolidating the facilities of the 21 airlines serving the city, the terminal will be used by 5,000,000 air passengers annually. It will have roof-parking facilities for 275 cars as well as facilities for helicopter landing and take off. Located between 37th and 38th Streets and First and Second Avenues, with speedy access to La Guardia and Idlewild airports, the terminal will keep airline buses off congested mid-Manhattan streets. It will be managed by East Side Airlines Terminal Corp., a joint organization made up of the ten major airlines planning to use the facility. Completion in less than two years is scheduled.

A similar project will soon be started on the West Side, near Lincoln Tunnel, to serve Newark Airport, according to the Triborough Bridge and Tunnel Authority.

Allocation of Controlled Metals Is Determined by DPA

Program levels governing the use of copper, steel, and aluminum for production in the third quarter of 1951 have been made public by the Defense Production Administration's Office of Program and Requirements. The program determinations were made for the convenience of the National Production Authority and other delegate agencies in making individual allocations of the three controlled metals under the Controlled Materials Plan.

With total unrestricted demand for copper, steel and aluminum for the third quarter about 35 percent in excess of supply, it was necessary to review the needs of military, defense-supporting and civilian programs and establish authorized levels of procurement for all consumption of the controlled metals.

Production of copper and copper-base alloys is expected to total about 1,114,000,000 lb in the third quarter; steel, 20,825,000 tons, and aluminum 598,000,000 lb. In dividing up these available supplies, military and certain other programs under security restrictions were given first consideration. For the first time since DO priority ratings were issued last fall, the military is now operating under set quotas for the procurement of copper, steel and aluminum.

Under CMP the military issues allotments, within the over-all quota restrictions, for the production of military equipment. After these provisions have been made for the military, remaining supplies of copper, steel and aluminum are considerably below requirements. To bring demand and supply into balance, the DPA considered two related problems—maintenance of maximum levels of production of consumer durable goods, while giving the greatest possible impetus to the production of defense-supporting and other essential programs.

Non-defense consumption of controlled materials was reduced in general by limiting purchases to fixed proportions of "normal" usage. In the case of steel, manufacturers of consumer durable goods other than automobiles were limited to 70 percent of their quarterly rate of consumption during the first half of 1950. Consumers of aluminum were held, in general, to 50 percent of their non-defense consumption during the same period. The copper allowance was 60 percent. In the case of passenger automobiles, third-quarter production was limited to the materials required to produce approximately 1,200,000 units.

Handbook on Construction Cost Control Available

To meet the need for a practical reference work on construction accounting and cost control, the Committee on Basic Accounting and Cost Control Procedure of the ASCE Construction Division has prepared an authoritative handbook entitled *Construction Cost Control*. The 97-page, leather-bound volume includes sections on Preliminary Estimating, Budgeting, Classification of Construction Cost Accounts, Distribution of Costs, Control of Costs, Time and Motion Studies and Financing and Tax Problems. It is illustrated with photos of construction projects and documented with charts and specimen accounting forms.

Members of the Committee on Basic Accounting and Cost Control Procedure are Howard P. Maxton, Arnold O. Babb, and Donald J. Leitch.

Full details, including prices and a form for ordering, are given on page 92 of this issue.

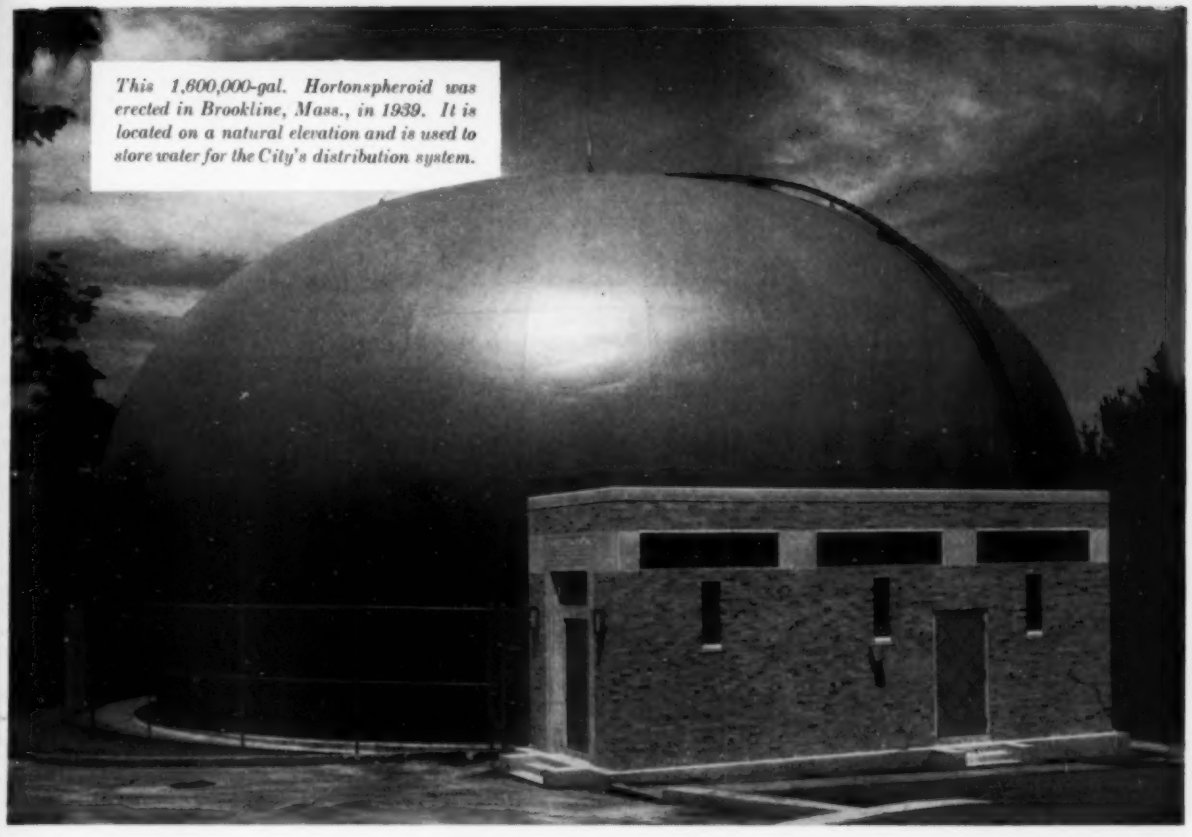
Joint Contractor-Producer Group Is Established

Formation of a national joint cooperative committee for the study of problems of mutual interest is announced by the Producers' Council and the Associated General Contractors of America. The purpose of the joint committee is to provide a medium through which producers of building materials and general contractors can cooperate to increase the efficiency of the industry. The committee will consider material requirements for the defense program and other subjects and projects suggested by construction industry groups.

Natural Resources Are Discussed by Governors

Common problems in the field of natural resources and mobilization were discussed at a recent two-day conference of Midwestern governors and industrial leaders in Omaha, Nebr. Interregional aspects of food, power, irrigation, transportation, and other related benefits of resource programs, such as the St. Lawrence Seaway project, in the mid-continent area, were studied by nearly 1,000 delegates from the 15 states representing agriculture, commerce, labor, transportation, and government.

Highlighting the conference were talks by Oscar L. Chapman, Secretary of the Interior, and Frank C. Pace, Secretary of the Army, who spoke on hydroelectric power and resource development in the light of the national emergency. Maj. Gen. Lewis A. Pick, M. ASCE, Chief of Engineers, discussed "Water and Rail Transportation in Inland America."



This 1,600,000-gal. Hortonspheroid was erected in Brookline, Mass., in 1939. It is located on a natural elevation and is used to store water for the City's distribution system.

Cut Maintenance Costs with the Phoscote Process

The Phoscote Process is a proven method of cleaning and preparing the surfaces of steel plates and shapes before erection. It efficiently removes the mill scale from the steel and provides a better bond between the paint and the metal.

The plates used in building the Hortonspheroid shown above at Brookline, Massachusetts, were treated by the Phoscote Process to assure a longer, more serviceable life. Protection against corrosion is especially important in New England's hard water areas.

The Phoscote Process consists primarily of four successive steps—as follows:

1) Immersing the steel in a hot sulphuric acid bath until the mill scale is removed.
2) Dipping the steel into a wash bath to rinse off the residual sulphates. This water is continuously replenished to prevent an accumulation of sulphuric acid.
3) Immersing the steel in a hot phosphoric acid solution into which a small amount of iron has been added. This deposits a coating of iron phosphate on the surfaces of the steel.
4) Painting with a special prime coat while the steel is still warm. This eliminates any danger of the surface becoming moist or dirty before the paint is applied, and improves the adhesion of the coating.

Field inspections of many Horton installations at various locations indicate that steel treated by the Phoscote Process does not corrode as fast as the plates in tanks built of untreated steel. Naturally this means lower maintenance costs and longer tank operation.

We now have facilities for pickling and painting steel by the Phoscote Process at our Birmingham, Chicago and Greenville, Pa., plants. Over 500 jobs including oil storage tanks, floating roofs, water tanks, standpipes, elevated tanks, and steel pipe have been treated by this proven process.

When you order Horton steel tanks or plate work, be sure to have the mill scale efficiently and economically removed by the Phoscote Process of pickling and painting. The passing years will prove your judgment. For more complete information and quotations write our nearest office for Bulletin I. There is no obligation on your part.

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Los Angeles 17..1556 General Petroleum Bldg.
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Philadelphia 3..1652—1700 Walnut St. Bldg.
Salt Lake City 4...509 West 17th South St.
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Washington 6.....1647 Cafritz Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

Sampson Air Force Base to Have New Facilities

Award of a $4,126,251 low-bid contract for construction of additional facilities at the Sampson Air Force Base, near Geneva, N.Y., to the Merritt-Chapman & Scott Corp. of New York, is announced by the New York District of the Army Corps of Engineers. Work under the contract, which is part of an over-all project to convert the World War II Sampson Naval Training Station into an Air Force training base, will include construction of 30 barracks, two administration buildings, two central heating plants, and an underground steam distribution system.

Col. E. P. Ketchum, district engineer at New York, will be in over-all charge of the project, with Maj. Mike Davis serving as project engineer. Norman Eastwood and George Deane will be project manager and general superintendent for Merritt-Chapman & Scott at the site.

Chicago Makes Plans for Large Filtration Plant

An interest-free advance of $486,000 to assist the City of Chicago with engineering studies and the preparation of plans and drawings for a Central District Filtration Plant has been approved by the Housing and Home Finance Agency. The proposed plant, consisting of 23 units, will be built on about 60 acres of submerged land, to be filled in the Outer Harbor east of Lake Shore Drive and north of Navy Pier, and will extend from points opposite Chicago Avenue and Ohio Street. It will provide filtered water for approximately 3,000,000 residents of Chicago and adjacent suburbs at an estimated cost of $78,119,760.

Lake Michigan water at Chicago has so high a coliform bacteria content that it cannot be treated by chlorination alone and filtration is necessary according to the U.S. Public Health Service. Filtration needs are now partially served by the South Side Filtration Plant, which was constructed during World War II.

Engineers for the city on the project are W. W. DeBerard, Hon. M. ASCE, city engineer, and the firms of Alvord, Burdick & Howson and Greeley & Hansen.

Army Map Service to Open Several Field Offices

To increase essential map production required by the expanded military program, Maj. Gen. Lewis A. Pick, Chief of Army Engineers, announces the establishment of Army Map Service field offices in Louisville, Ky., and Kansas City, Mo. Plans for offices in other cities are also being made.

The new field offices, operating directly under the Commanding Officer, Army Map Service, Washington, D.C., will be similar to those established during World War II, with drafting and map compilation from source materials furnished by the base plant in Washington as the main activities. Each field office will employ between 150 and 200 locally recruited personnel, mainly draftsmen, with a salary range of $2,450 to $4,200 a year.

Remobilization Program in Jeopardy ASEE Told

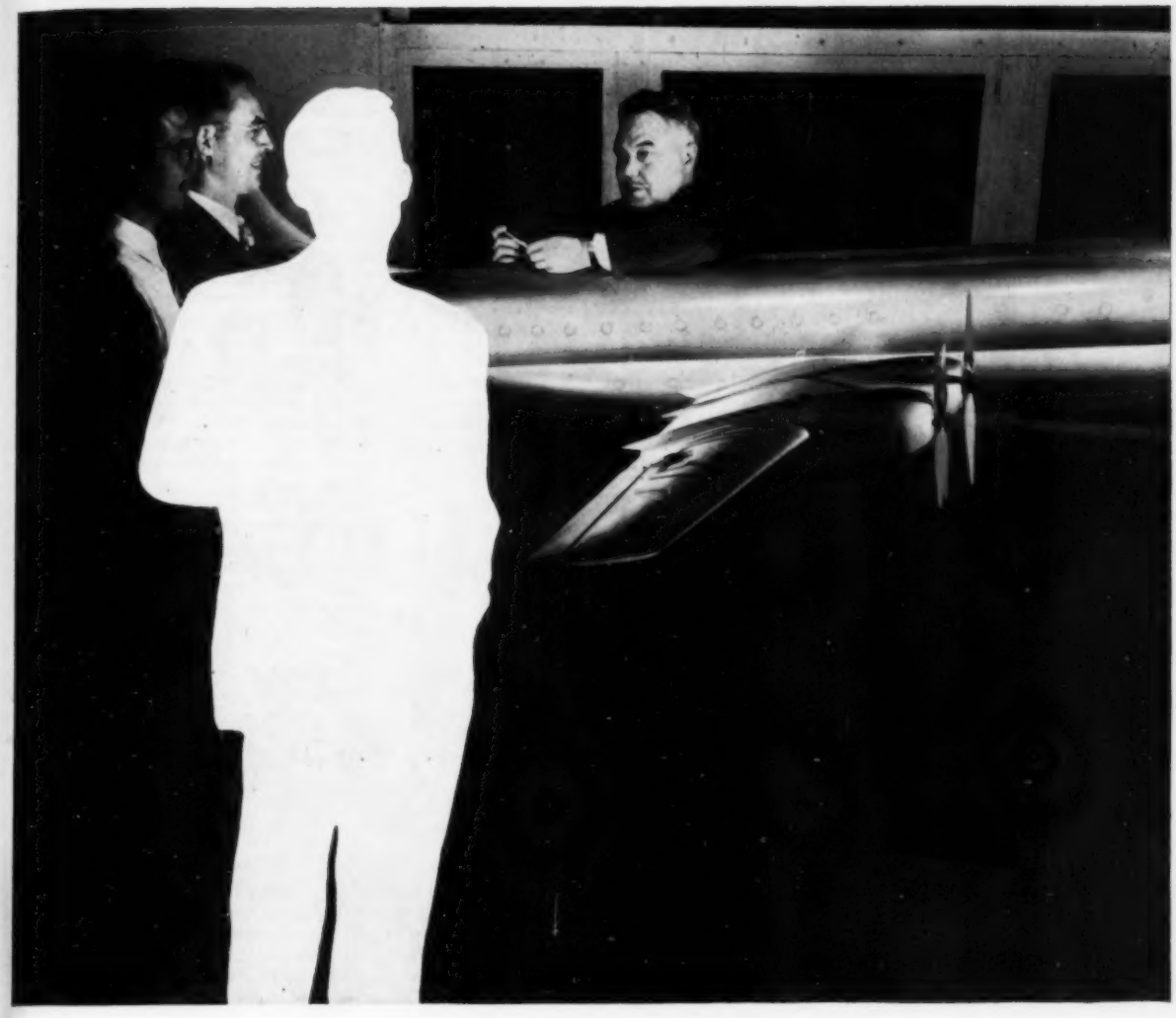
The current unfilled demand is for more than 60,000 engineers, exclusive of military needs, even after the 1951 graduating class is absorbed, Carey H. Brown, chairman of the Engineering Manpower Commission of Engineers Joint Council, revealed at the recent 59th annual meeting of the American Society for Engineering Education, held at Michigan State College, East Lansing, Mich. Mr. Brown based his statement on a June 1951 survey of the needs of 378 companies and government agencies made by the Education Committee of the Engineering Manpower Commission.

To meet vastly increased demands for military research, the Engineering College Research Council of the ASEE advocated, during the meeting, that college and university research activity be augmented by (1) utilizing to a greater extent the faculties and facilities of smaller colleges and universities doing academic work in the physical and engineering sciences, and (2) increasing the activity of graduate students and junior staff members on military research projects at all educational institutions.

Dean A. F. Spilhaus, of the University of Minnesota, reporting on a survey of more than 700 educational institutions by a committee of the Research Council, told a general session of the ASEE that these two steps can immediately increase the educational institutions' share of national defense research needs. Dr. Eric A. Walker, executive secretary of the Research and Development Board, told the session that today's $1.1 billion military research budget requires nearly half the total number of research scientists and engineers in the United States. Necessary expansion in 1952 will bring this figure to 70 percent.

During the meeting S. C. Hollister, M. ASCE, of Cornell University, was elected president for the coming year, succeeding Dean F. M. Dawson, M. ASCE, of the State University of Iowa. New chairman of the civil engineering division is Prof. Edwin H. Arnold, of Ohio State University.

ASEE OFFICERS SHOWN IN CONFERENCE at 1951 convention are (left to right, front row) Henry H. Armsby, Associate Chief of Engineering, U.S. Office of Education, vice-president; Dean F. E. Torman, Stanford University, vice-president; and Dean S. C. Hollister, Cornell University, president-elect. In back row are Dean F. M. Dawson, State University of Iowa, president, and Dr. Gerald A. Rosselot, Georgia Institute of Technology, vice-president.



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3 The invigorating atmosphere of the Pacific Northwest—hunting, fishing, sailing, skiing, temperate climate all year around.

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Neare's N. G. COLUMN

R. Robinson Rowe, M. ASCE

"Professor Neare, I want to confess that I'm awfully proud of myself," said Joe Kerr. "I found out how to solve the bear problem that was so difficult you reassigned it."

"Noah let me reassign it," corrected Guest Professor Stoop Nagle, "so I'll ask how."

"By solving a lot of triangles and averaging the results. Calling the vertices P for 'pole', C for 'camp' and B for 'bear,' PC was given as 146 yd. Now if the bear runs 99 yd south and 47 yd east, the last course is a curve centered at P, so $PB = 99$. The included angle at P is $\frac{47}{99}$ radian plus the random angle with respect to PC at which the bear left the pole. So if I select a lot of evenly distributed random angles, solve for BC by the law of cosines and compute the mean BC, that will be the distance the hunter probably had to drag the bear."

"A stupendous chore," said Cal Klater. "First of all, you can consider the included angle P as the random angle and forget the run of 47 yd east, which is just a nuisance-type redundant. Then why not compute the mean value by calculus? In general form, we start with

$$x = c\int p\,dP + c\int dP \quad \ldots\ldots\ldots\ldots [1]$$

where c, p, P are sides and random angle of triangle BCP and, because of symmetry, the limits of integration are 0 to π. Obtaining p from the law of cosines, cancelling c and evaluating the second integral,

$$x = \frac{1}{\pi}\int_0^{\pi} \sqrt{b^2 + c^2 - 2bc\cos P}\,dP \ldots [2]$$

This is a complete elliptic integral of the second kind, for which the solution is

$$x = \frac{2}{\pi}(b+c)\,E\left(\frac{2\sqrt{bc}}{b+c}\right) \ldots\ldots [3]$$

Substituting $b = 146$ and $c = 99$, I found $x = 163.3333$ yd or 490 ft."

"Which is why I knew you knew the answer last time when you started to give it in feet. The 99 and 146 were selected to make $3E = \pi$ and $b + c$ in yd equal x in feet. However, I don't agree that Joe's method is a stupendous chore. The mean of the two extremes is 146; the mean of these and two midway points is 161.2; add in four more midway points and the mean is 163.20 after figuring only three triangles. That would be close enuf, wouldn't it, Noah?"

"It would rate a strong A−, Stoop, which makes it a good problem for both Joe and Cal. Practical, too, for Eq. 3 would give the mean distance between points of clock hands, or between you and your son on the carousel. Flo Ridan claims we can have just as much fun with semicircles at half the cost, so I've asked him for a sample."

"My sample, Noah, is the Demiluna Pool, which is semicircular with a high wall for the springboard along the diameter. The old plans had been folded, deleting the diameter except for '−.00.' I started to recover the diameter by measuring chords and broke my tape. Having only foot marks on the long piece, I overcame the handicap by finding two points B and C on the semicircle so that chords $AB = 73$, $BC = 37$ and $CD = 47$ closed on the diameter AD. How big was the pool?"

[Cal Klaters were Richard Jenney, Flo Ridan, and Marvin A. (Sauer Doe) Larson. Guest Professors Stoop Nagle and Flo Ridan were John L. Nagle and Charles G. Edson, respectively.]

DECEASED

Arthur Adams (M. '18) assistant to the president of the Macon Kraft Co., New York N.Y., died on October 22, 1950, according to word just received at Society Headquarters. He was 71. Soon after graduation from Cornell University in 1901, Mr. Adams became associated with the state engineer of New York, working on the Barge Canal. Subsequently he was employed by the J. G. White Engineering Corp., the Montreal Tramways Co. and the Nova Scotia Power Co. He established his own consulting practice in 1914 and during World War I served in the Ordnance Department of the U.S. Army, advancing to the rank of lieutenant colonel. From 1923 to 1939 he was engaged in various engineering and executive capacities by industrial corporations, more recently as assistant to the president of the Macon Kraft Co.

Charles Moses Coff (M. '49) civil engineer in the U.S. Engineer Office at Denver, Colo., died recently, at the age of 57. Earlier in his career Mr. Coff was employed as engineer-manager for the Morrison-Knudsen Co., Inc., Hans, Daugherty & Jones, and J. A. Terteling & Sons. Of more recent years he had been with the Koehler Construction Co., the U. S. Public Works Administration, and the Nebraska State Department of Roads and Irrigation. During the second World War he served in the Army Corps of Engineers, having charge of administration and construction of military installations. He joined the Denver Engineer Office in 1946, and at the time of his death was civil engineer and head of the construction schedules and progress group. He graduated from Valparaiso University.

Raymond Francis Fletcher (M. '47) senior architectural and civil engineer for the E. I. du Pont de Nemours & Co., at Wilmington, Del., died on December 26, 1950, though notice of his death has just reached Headquarters. He was 49. Earlier in his career Mr. Fletcher worked for several architectural and engineering firms in Philadelphia. He became connected with the du Pont Co. in 1934, serving successively as design engineer, structural engineer, process engineer, and for the past six years senior architectural and civil engineer.

R. F. Fletcher

Herman G. Crow (Assoc. M. '15) for the past 22 years city manager for St. Joseph, Mich., died on June 8, at the age of 67. Upon his graduation from Ohio State University, Mr. Crow entered the employ of the county surveyor of Fayette County, Ohio. From 1909 to 1911 he was assistant engineer on construction and maintenance for the Toledo, St. Louis & Western Railroad. He was successively connected with Jeupe & Moore, Indianapolis, Ind., consultants; the Chicago, Milwaukee & St. Paul Railroad; and M. E. Cooley.

Dugald Caleb Jackson (M. '98) professor emeritus at the Massachusetts Institute of Technology, Cambridge, Mass., died on July 1. He was 86. Professor Jackson's early experience included work as engineer for the West Engineering Co., at Lincoln, Nebr.; assistant chief engineer for the Sprague Electric Railway and Motor Co., of New York City; and chief engineer for the Central District Edison General Electric Co. From 1891 to 1930 he engaged in private consulting practice, becoming senior member in the firm of D. C. & Wm. Jackson and its successor concern, Jackson & Moreland. He also served on the University of Wisconsin faculty, and was professor in charge of the department of electrical engineering at M.I.T. advancing to emeritus status in 1935. He received his B.S. and C.E. degrees from Pennsylvania State College, and honorary degrees from Columbia and Northeastern universities.

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D. C. Jackson

(*Continued on page 78*)

to aid peak defense production

Collect and Sell your Iron and Steel Scrap

Mr. Q-Check says *dig* for scrap metal—*search* every nook and corner of your pipe yard—*scrape* the bottom of the barrel! For iron and steel scrap is critically needed to aid peak defense production in steel mills and iron foundries.

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Obsolete fittings; cut pipe (short pieces of distribution or service pipe); damaged hydrants, valve boxes, manhole covers, etc. It all adds up to a vital contribution to defense production.

Collect your scrap now. Phone your nearest scrap dealer. He wants what you have *but quick*, and pays good cash prices.

CAST IRON PIPE RESEARCH ASSOCIATION . . . CHICAGO

Deceased

(*Continued from page 76*)

Albert Harrison Hinkle (M. '17) division director of the Asphalt Institute at Columbus, Ohio, died there on June 8, at the age of 71. After receiving a degree from Ohio State University in 1907, Mr. Hinkle became deputy county surveyor for Darke County (Ohio); assistant in the civil engineering department at Ohio State University; and from 1911 to 1919 deputy state highway commissioner of Ohio. Subsequently he served as chief engineer and superintendent of maintenance in the Indiana State Highway Department (1919–1933); director of the Public Works Administration in Indiana; and research engineer for the Kentucky Rock Asphalt Co. In 1939 he joined the Asphalt Institute as district engineer in Cincinnati, becoming division director of the Institute when the office was moved to Columbus.

Myron Tuttle Jones (M. '45) consulting engineer of Columbus, Ohio, died in June 1950, according to word recently received at Society Headquarters. His age was 52. Mr. Jones did planning and other engineering work for the City of Cleveland, Ohio, and its environs from 1921 to 1934. Later he served as resident engineer and inspector for the Public Works Administration, at Cincinnati, Ohio; engineer in the U.S. Engineer district office at Cincinnati and Bellevue, Ohio, and Buffalo, N.Y.; and consultant to the Bellevue Flood Relief Committee. Since 1943, Mr. Jones was engaged in private consulting engineering practice.

John Scott McWilliams (Assoc. M. '27) since 1922 president of the Roaring Creek Water Co., at Shamokin, Pa., died on February 3, at the age of 54. In his connection with the organization Mr. McWilliams advised on the design and erection of two storage reservoirs and extensions made to the company's transmission and distribution systems. Earlier he was manager of the Bear Gap Water Co., also of Shamokin, Pa. He was educated at the Massachusetts Institute of Technology and Princeton University.

Edward Leyburn Moreland (M. '28) retired dean of engineering and vice-president of the Massachusetts Institute of Technology and partner in the consulting concern of Jackson & Moreland, of Boston, Mass., died on June 17, at the age of 65. After receiving his degrees from Johns Hopkins University and the Massachusetts Institute of Technology, Mr. Moreland was employed as assistant engineer for D. C. & Wm. Jackson, in Boston, Mass. In a few years he became manager of the Boston office of that organization, and in 1916 entered into partnership (Jackson & Moreland). He served in the A.E.F. in France during World War I, resuming partnership with Dugald C. Jackson in 1919. Later he formed a partnership with Frank M. Carhart & Ralph D. Booth, using the firm name of Jackson & Moreland. He also was head of the electrical engineering department, dean of engineering, and executive vice-president at M.I.T.

Hans Mumm, Jr. (M. '20) of Everett, Wash., died on January 6, at the age of 73. Mr. Mumm began his engineering career doing survey and maintenance work for several Western railroads. Subsequently he was assistant city engineer for Everett, Wash., engineer for the Everett Improvement Co., and city engineer for Everett. He practiced engineering from 1909 to 1913, when he became engineer for Snohomish County, Washington. Later he joined the Portland Cement Association and in 1926 formed the Everett Concrete Products Co., acting as president and manager of the business before retiring in 1941. He was a Washington State College graduate.

Fred John Nebiker (Assoc. M. '27) for a number of years senior engineer for the Corps of Engineers, at Boston, Mass., died on June 30. He was 55. Mr. Nebiker, who had been connected with the U.S. Engineers for the past 18 years, worked on the design of Bedford, Westover, and Grenier airfields. Before that he made hydraulic studies on water power projects along the Rhine for O. Bosshardt, consulting engineer of Basel, Switzerland, and later was with the Florida Development Co., at Everglades, Fla., and Hills & Youngberg, Jacksonville consultants. He graduated from the Swiss Federal Polytechnic University.

Anant Hiralal Pandya (M. '46) chief engineer and director of the Patel Engineering Co., Ltd., and consulting engineer for Hind Constructors Ltd., at Bombay, India, was killed in an automobile accident near Konar Dam, Hazaribagh, on June 1. He was 41, and a graduate of Bombay University and the Massachusetts Institute of Technology. At the outset of his career Mr. Pandya was associated with Messrs. Truscon, Ltd., the Trussed Concrete Steel Co., and Diagrid Structures Ltd. He returned to India in 1939, successively as principal of the Bengal Engineering College at Calcutta; director of the Supply Department and deputy director general of Munition Production; and general manager of Hindustan Aircraft Ltd. He was the recipient of many research fellowships and awards, including the Lincoln Arc Welding Prize in 1938.

A. H. Pandya

Victor Hugo Reichelt (M. '24) engineer of Upper Montclair, N.J., died in March. He was 79. At the outset of his career Mr. Reichelt worked for Charles Busath and W. T. Vajen. In 1897 he joined the New York City Department of Street Improvement and later was associated with the office of the Borough President of the Bronx. He became connected with office of the Borough President of the Borough of Richmond in 1902, serving as draftsman, transitman, and assistant engineer in charge of the Sewer Design and Substructure Division. In recent years he practiced engineering in Upper Montclair, N.J. He received his engineering training at Cooper Union and Columbia University.

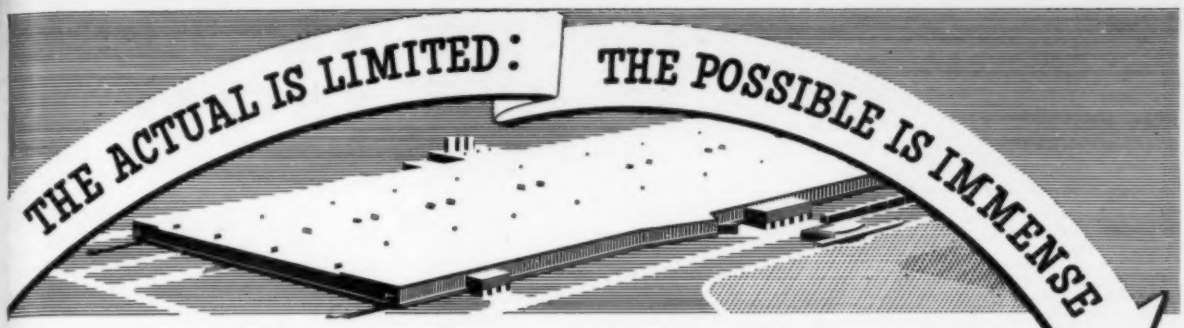
Frank Erwin Richart (M. '29) for the past 20 years research professor of engineering at the University of Illinois, Urbana, Ill., died on July 16, at the age of 59. Earlier in his career Mr. Richart was associated with W. A. Baehr and the C. F. Massey Co., of Chicago, Ill. Except for a year as structural engineer on experimental work in the Concrete Ship Section of the Emergency Fleet Corp., at Philadelphia, Pa., he had been on the faculty of the University of Illinois, his alma mater, since 1916. Noted for his reinforced concrete research, Mr. Richart devised a new bridge building technique. He was a past-president of the American Concrete Institute and had served on numerous ACI research and testing committees. He had also been active in the American Society for Testing Materials, which awarded him honorary membership just before his death.

F. E. Richart

Eugene Somers (Assoc. M. '25) design engineer for the Universal Atlas Cement Co., in New York, N.Y., died at his home in Westfield, N.J., on February 25, according to word recently received at Headquarters. During the early part of his career Mr. Somers was connected with several New Jersey surveyors and architects. He entered the employ of E. D. Rightmire, civil engineer of Atlantic City, in 1907, and worked on the design and construction of roads, bridges, and sanitary improvements. Later he became associated with various cement companies, including the Atlas Portland Cement Co., the Bessemer Cement Corp., and more recently the Universal Atlas Cement Co.

Edward John Spoerer (Assoc. M. '22) since 1927 superintendent of buildings for the Building Department, at Jersey City, N.J., died on March 6, at the age of 61. With the exception of a year as detailer and designer on structural steel for the Hinkle Iron Co., Mr. Spoerer was employed by Waldemar Mortensen, New York City civil engineer, from 1910 to 1921, as designer and structural engineer. He subsequently became structural engineer and superintendent of buildings for the Jersey City Building Department. He received his education at Cooper Institute.

Alexander Raffen Webb (M. '22) dean of the college of engineering at Ohio Northern University, Ada, Ohio, died there on June 29, at the age of 64. Educated at the Armour Research Institute of Technology and the University of Michigan, Mr. Webb first worked for irrigation and land development companies in Oregon and Florida, and the Chicago, Burlington & Quincy Railroad, at Chicago, Ill. He began his teaching career at Highland Park and Des Moines colleges, and served as assistant professor of civil engineering at Idaho University and professor of civil engineering at the University of the Philippines. In 1924 he joined the Ohio Northern University faculty, becoming dean of the college of engineering in 1946.



NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

© LE Co. 1951

WELDED FRAMEWORK SAVES 36 TONS OF STEEL

By **J. R. Braun**, Vice President
Byrne Organization, Inc.
Engineers and Contractors
Washington, D. C.

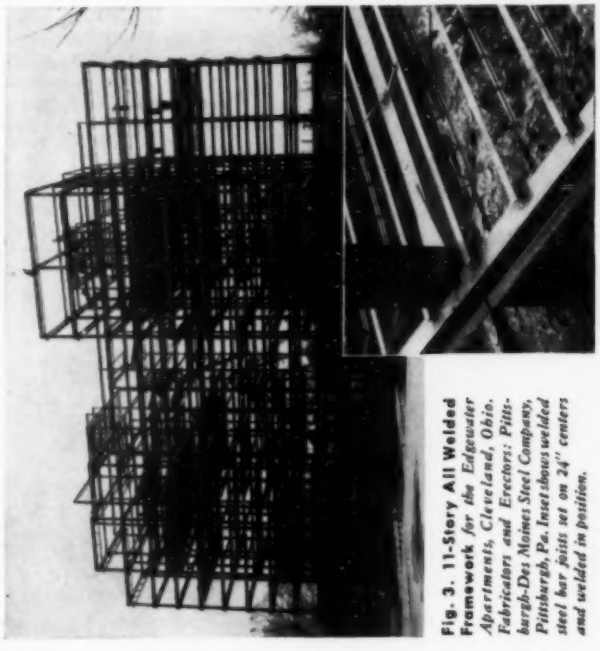


Fig. 3. 11-Story All Welded Framework *for the Edgewater Apartments, Cleveland, Ohio. Fabricators and Erectors: Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa. Inset shows welded steel bar joists set on 24" centers and welded in position.*

WELDED design is cutting 5% from the labor costs of fabricating and erecting the 11-story Edgewater Apartments at Cleveland, Ohio. Simpler details of frame connections, made possible only with welded designs, are also helping to effect savings of 25% in weight of connections and a 3% reduction in total weight of this 1200 ton framework.

Each design detail utilizes the full economies of welded construction. Connections are so engineered as to allow fast, low cost shop fabrication and yet permit flat position field welding on every joint.

SIMPLER COLUMN SPLICES

Fig. 1. Typical Welded Splice *of all columns 12 to 12 and 12 to 14 WF column. Bearing plate is shop welded to lower column . . . clip angle for erection bolts is shop welded to upper column. All field welds are made in fast, easy downhand position.*

FASTER BEAM-TO-COLUMN CONNECTIONS

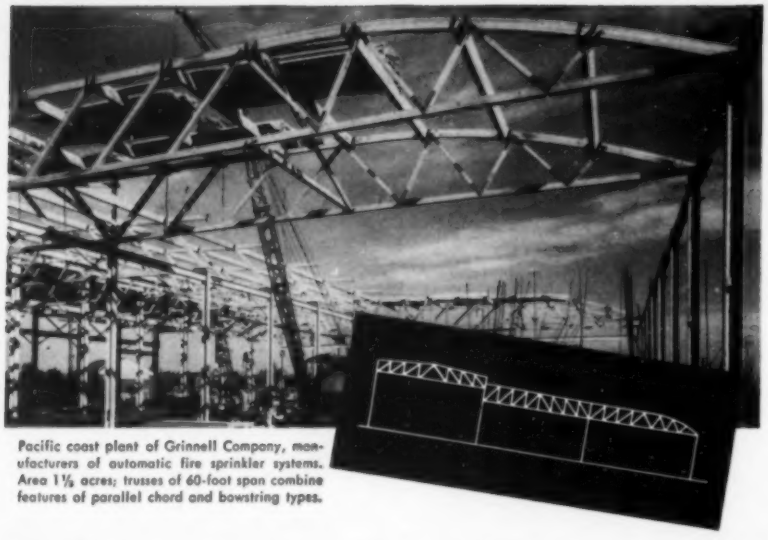
Fig. 2. Simpler Detail Speeds Erection. *Clip angle is shop welded to column for bolting beam in the field. Outside cover plates are then field welded to top and bottom flanges and the top plate to column in flat position with Lincoln "Fleetweld 5" electrodes. Bottom plate is shop welded.*

WELDED DESIGN SAVES 25% ON WEIGHT OF CONNECTIONS

SEE HOW WELDED DESIGN SPEEDS ERECTION OF MULTI-STORY BUILDING

Studies in Structural Arc Welding free on request. Designers and engineers write on your letterhead to Dept. 143,

THE LINCOLN ELECTRIC COMPANY
CLEVELAND 1, OHIO



Pacific coast plant of Grinnell Company, manufacturers of automatic fire sprinkler systems. Area 1½ acres; trusses of 60-foot span combine features of parallel chord and bowstring types.

Skeleton of a Production Tool

TRUSSES of engineered timber provide the expanse of open floor space which will make this building a primary production tool. Unhampered by an excessive number of interior posts, continuous flow of mass production is possible; materials handling equipment functions efficiently; flexibility is retained for expansion, changes of tenants, and new production processes and machinery.

Wide Range of Adaptations

Trusses in this building are typical of the adaptability of Timber Structures units. Other types provide saw tooth, flat or arched roof contours, or any desired combination of these forms. Spans may be up to 250 feet or more, and number of spans is limited only by site conditions. Local loadings such as mezzanines, balconies, monorail installations and heating and cooling units are readily accommodated in design.

Resistive to Destruction by Fire

Truss chords shown here are formed by glued lamination into single piece members, permanently free from seasoning action, and qualifying as heavy timber or mill type construction. They are naturally resistive to failure by fire and earn moderate insurance rates.

For additional information about these structural units, get a copy of the booklet, "Industrial Buildings" from your nearest Timber Structures representative, or fill in and mail the coupon.

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NEWS OF ENGINEERS

Gano Dunn, since 1925 a trustee and for the past 16 years president of Cooper Union, has been named chairman of the trustees in accordance with the recently revised by-laws of the institute. Mr. Dunn is president of the J. G. White Engineering Corp., of New York City, and an Honorary Member of ASCE.

Albert Haertlein, Gordon McKay Professor of Civil Engineering at Harvard University, has been appointed associate dean of applied science. His new duties will involve research and teaching work in the properties of materials. Professor Haertlein is currently serving as Vice-President of ASCE.

H. H. Nicholson, construction engineer in the Fort Peck District of the Corps of Engineers, has accepted appointment as chief of the Construction Supervision and Inspection Branch of the Construction Division at the Omaha, Nebr., District of the Corps.

Charles R. Harte, for the past 53 years on the engineering staff of the New Haven Railroad, and its subsidiary, the Connecticut Co., at New Haven, Conn., has retired. He is responsible for much of the work of four-tracking the main line and for early electrification projects of the railroad.

L. F. Harza, president of the Harza Engineering Co., in Chicago, Ill., recently received honorary membership in the Chicago Engineers Club.

Charles MacClosky, who is head of his own contracting firm in San Francisco, Calif., and a member of the 499th Engineer Brigade (Reserve), was advanced to the rank of colonel at recent ceremonies conducted at the Presidio of San Francisco.

T. H. Cutler, engineering consultant to the Kentucky Department of Highways, at Frankfort, has been appointed to the newly created post of engineer-manager of urban development. Mr. Cutler will have direct charge of projects in the urban development program, including major improvements to congested business districts, limited access highways, and expressways.

P. H. Daniells, who is assistant chief engineer for the Missouri State Highway Department, at Jefferson City, was recently elected president of the Mississippi Valley Conference of State Highway Departments.

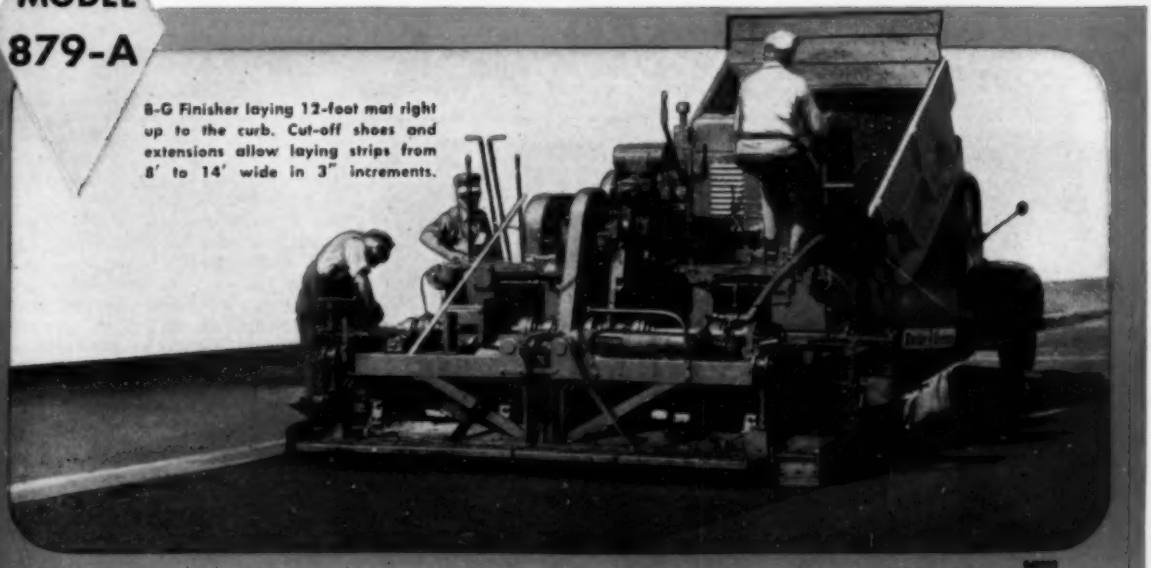
Helmer A. Holmstrom, lieutenant colonel, Corps of Engineers, recently graduated from the Command and General Staff College, at Fort Leavenworth, Kans., and is now stationed at the Armored Airborne Center, Fort Bragg, N.C.

(*Continued on page 82*)

Barber-Greene

TAMPING-LEVELING FINISHER

MODEL 879-A



B-G Finisher laying 12-foot mat right up to the curb. Cut-off shoes and extensions allow laying strips from 8' to 14' wide in 3" increments.

SPREADS material evenly

COMPACTS to uniform density

LEVELS automatically without forms

Unequaled method for properly laying a smooth, level surface for paving streets, highways, runways, parking lots, tennis courts and similar jobs.

The world's most widely used paving machine: gives superior performance in laying every type of surface—hot or cold—from clay stabilized gravel to high-type sheet asphalt.

Tamps, levels and strikes off simultaneously: *automatically* measures the correct amount of *compacted* material, produces a level surface that is maintained under rolling and traffic.

Compacts material as it is being laid: while it is hot and workable—assures a superior surface of uniform density, even when laid over an irregular subgrade.

Whether paving over new subgrade or resurfacing existing pavement, the B-G leveling principle assures a smooth, ripple-free surface without the need of forms . . . abrupt changes in subgrade cannot change the grade line of the mat.

High capacity with low maintenance: saves truck time, reduces the amount of rolling required and size of crew.

"See Your B-G Distributor"

Barber-Greene Company

Aurora, Ill., U.S.A.

210A

News of Engineers

(*Continued from page 80*)

Charles W. Harris has retired after 45 years on the civil engineering faculty at the University of Washington. He will have the rank of professor emeritus of hydraulic engineering.

Richard T. Evans, topographic engineer, and **Frederick M. Hart,** cartographic engineer for the U.S. Geological Survey, in Washington, D.C., who retired on July 31, were presented scrolls marking their service of 52 and 51 years, respectively.

Glenn Murphy, professor of theoretical and applied mechanics and senior engineer for the Iowa State College Institute for Atomic Research, has been named the sixth recipient of the George Westinghouse Award of the American Society for Engineering Education. Professor Murphy was cited for his "preeminence as a teacher in engineering."

William J. Bona recently resigned as engineer for the Corps of Engineers at Rock Island, Ill., and is now with Ebasco Services, Inc., with headquarters in Metropolis, Ill.

James F. Smythe is on leave from the Wigton-Abbott Corp., to serve with the International Bank of Reconstruction and Development in Washington, D.C., assisting **Lt. Gen. R. A. Wheeler,** engineering adviser, on the end-use supervision of loans.

William H. Hasselbach, since 1943 chief engineer of the Libbey - Owens - Ford Glass Co., has accepted appointment to the post of director of engineering, with headquarters in Toledo, Ohio. Mr. Hasselbach has been connected with the Libbey - Owens - Ford engineering division for nearly 22 years. He is a past-president of the Toledo Section of ASCE, and an honorary member of Tau Beta Pi.

W. H. Hasselbach

George L. Freeman, consulting engineer with the New York City firm of Moran, Proctor, Freeman & Mueser, has retired. He will continue to serve the organization in an advisory capacity.

Ralph Smillie has been retained by the Port of New York Authority as consultant to the chief engineer and the engineering department in connection with the third tube of the Lincoln Tunnel, which will be constructed at a cost of $85,000,000.

Valentine F. Spring, formerly chief of the Civil Works Branch of the Antilles Area Office, Panama District of the Corps of Engineers, at San Juan, Puerto Rico, has retired after approximately 34 years of service. He is making his residence in Hudson, Mich.

Edward P. Palmer, president of the New York consulting concern of Senior & Palmer, announces that its offices are now located at 1999 Park Avenue, New York City.

Robert B. Banks, for the past two years H. H. Hilp Fellow in Engineering at the University of California, has been awarded a Fulbright Fellowship at the Imperial College in London, for the academic year 1951–1952, to continue his research in hydraulics. Mr. Banks received his Ph.D. in civil engineering from the University of California.

Reamy C. Fitch announces the opening of a consulting engineering office at 650 North First Avenue, Phoenix, Ariz. Previously, Mr. Fitch served as engineer and estimator for the Farwell Co., Inc., at Dallas, Tex.

R. A. Haber, formerly assistant to the director of the Delaware River Crossing Division of the Delaware State Highway Department, at Wilmington, has become chief of the department there.

Harry R. Hall has retired as chief engineer of the Washington Suburban Sanitary Commission, at Hyattsville, Md., after 33 years of service.

William M. Hoge, major general in command of the U.S. Ninth Corps, has been nominated to the rank of lieutenant general.

John S. Crandell has retired as professor of highway engineering at the University of Illinois after 25 years of service.

If yours is one of the pioneer cities planning a fluoridation program, it will pay you to come to %Proportioneers% for your equipment. Already we have had almost six years' experience in this revolutionary phase of water treating. Whether you want a simple chemical feeder, or a complete installation with accessories for automatic proportional fluoridation, you're sure and you're safe if it's %Proportioneers%. Mail coupon or write for data and recommendations.

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Roy V. Lund, previously assistant supervising engineer in the physical plant at the University of Minnesota, in Minneapolis, is now supervising engineer. Since 1922, Mr. Lund has been working in the physical plant at the university and in recent years directed its expansion program. He is a charter member of Chi Epsilon, honorary engineering fraternity.

R. V. Lund

John S. Telfair, Jr., until recently hydraulic engineer in the U.S. Engineer office at Jacksonville, Fla., has joined the municipal engineering firm of Smith & Gillespie, also of Jacksonville.

Allen Wagner has resigned as director of public relations for the American Road Builders' Association, Washington, D.C., to accept the position of assistant to the chairman of the U.S. Civil Service Commission, with headquarters in the same city. Before going to the ARBA, Mr. Wagner was public relations director for ASCE.

Cornelius Wandmacher, director of the evening session and associate professor of civil engineering at the Polytechnic Institute of Brooklyn, will become William Thoms Professor of Civil Engineering and head of that department in the University of Cincinnati College of Engineering, effective October 1. He succeeds **Prof. Howard B. Luther,** who is retiring after 29 years of service.

Frederick H. Warren has been made deputy director of the newly established Division of Construction and Supply of the Atomic Energy Commission, in Washington. He was formerly assistant to the director of production of the AEC.

Walter Owen Washington, for the past five years senior member of Washington & Ruff, civil engineers of Brownsville, Tex., has been awarded a certificate of merit for "fifty years of outstanding engineering work" by the Valley chapter of the Texas Society of Professional Engineers.

William Whipple, Jr., colonel, Corps of Engineers, has been graduated from the Industrial College of the Armed Forces and assigned to Fort McPherson, Ga., as engineer.

Lloyd O. Zapp is on a six-month leave of absence from the Humble Oil Co., to serve as chief of the Construction Branch of the Materials Division for the Petroleum Administration for Defense, in Washington. Mr. Zapp is senior supervising civil engineer for the Humble Co., at Houston, Tex.

Cliff Bales, formerly with the California Division of Architecture, has been recalled to duty with the Army, at McClellan Field.

Earle V. Miller has been appointed Idaho Highway Engineer. Mr. Miller has been with the Arizona Highway Department since 1923, most recently as deputy highway engineer.

August L. Ahlf, who has been connected with the U.S. Bureau of Reclamation at Denver, Colo., has gone to Siam for a year, where he will assist in the design and construction of irrigation works for the Siamese government, under the ECA program. He has been serving the Colorado Section of the Society as vice-president.

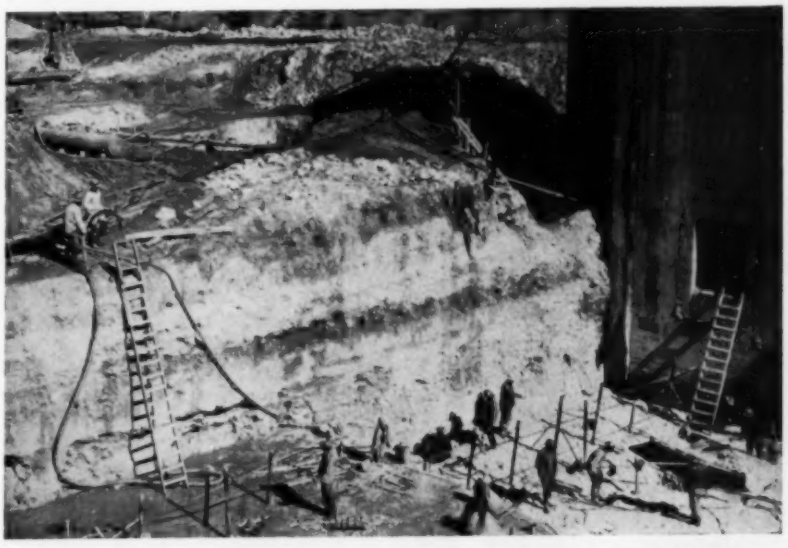
Frederick A. Reickert, associate professor of civil engineering at the University of Illinois, has been recalled to active duty with the Air Force and assigned as chief of the training analysis and development section of the 3499th Training Aids Wing, at Chanute Air Force Base in Illinois.

Prevost Hubbard has retired as engineer of research for the Asphalt Institute, New York City, after approximately 30 years of service.

Lloyd K. Clark, formerly project manager of the sanitary research project of the Association of American Railroads, in Baltimore, Md., has become sanitary engineering consultant to the Department of Health in Alaska.

Daniel Webster Cole, who retired several years ago from the engineering staff of Ebasco Services, Inc., was honored in a recent issue of the organization's *Ebasco News*, which cited his work in the development of hydroelectric resources in the Northwest and elsewhere in the United States.

(*Continued on page 84*)



HERE IS DIAMOND BIT EFFICIENCY AT "FISH TAIL" COST

Diamond drillers, drilling Ax, Bx and Nx grout holes through rough fossiliferous Tampa limestone and heavy shale at a Chattahooche River dam site, pictured above, were having slow going . . . bit costs were high. Rough formation damaged diamond bits and was too hard for other bits.

Their problem was solved when they switched to Hawthorne "Blue Demon" Rock Bits. "Blue Demons" drilled through clay, limestone, shale and even concrete, with a drastic reduction in drilling cost. Drilling was faster, bit costs lower and round trips fewer.

"Blue Demon" Bits, now drilling millions of feet each month, are designed for all sedimentary and overburden drilling where diamond bits can't be used. Bit sizes correspond with diamond bit sizes. Tungsten carbide facing does not shatter . . . gives longer life, more footage per bit. Low cost expendable blades give economic "on the drill" bit service.

Drillers on 900 drills throughout the world are drilling faster, with fewer bit changes, at drastically reduced drilling cost, with long lasting Hawthorne "Blue Demon" Rock Bits.

Use "Blue Demons" for diamond bit efficiency at "fish tail" cost in sedimentary drilling.

• *Mineral prospecting* • *Foundation testing* • *Grout hole drilling.*

HAWTHORNE "BLUE DEMON" ROCK CUTTER BITS REPLACEABLE BLADES

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News of Engineers

(*Continued from page 83*)

Gordon Long, until recently with the California State Division of Highways, is now with the Division of Water Resources, at Sacramento, as senior hydraulic engineer.

Ralph N. Ernest, captain, U.S. Navy, and a June 1951 graduate of the Industrial College of the Armed Forces, has been assigned to the Office of the Chief of Naval Operations, Department of the Navy, in Washington, D.C.

Robert E. Robertson, Jr., announces the termination of his partnership in the firm of Williar & Robertson, of Baltimore, Md., and the continuation of his practice under the name of Robertson & Associates, with offices at 339 St. Paul Place, in that city.

John R. Noyes, colonel, U.S. Army, and commissioner of roads for Alaska, at Juneau, has gone to the Far East on a new Army assignment.

Reginald C. Price is now director of the Division of Water and Power for the Department of the Interior, in Washington, D.C., succeeding **W. G. Hoyt,** who recently retired. Since 1947, Mr. Price has served as special assistant to the Assistant Secretary of the Interior.

E. C. Shuman, previously director of research in the Kaylo Division of the Owens-Illinois Glass Co., at Toledo, Ohio, has new duties as director of research and manager of product development there.

Edward J. Nunan has accepted appointment to the position of materials engineer and sales manager for the Buffalo Slag Co., Inc., with headquarters in the New York office.

W. F. Pruden, formerly assistant chief engineer of the Columbia Steel Co., a subsidiary of the U.S. Steel Corp., has been made chief engineer of the Columbia company, with headquarters in the new Russ Building in San Francisco, Calif.

W. G. Sloan, chairman of the U.S. Department of the Interior, at Billings, Mont., and co-author of the Pick-Sloan Plan for the development of the Missouri River basin, recently received the honorary degree of doctor of engineering from Montana State College.

Don Hoffman, consulting engineer of Placerville, Calif., is now serving as a colonel at the Joliet, Ill., Army Ordnance Depot.

Tahlman Krumm has been recalled to active duty as a lieutenant colonel on the general staff of the War Department, in Washington, D.C. Colonel Krumm is on leave of absence from his partnership with Burgess & Niple, consulting engineers of Columbus, Ohio.

P. H. Van Etten, assistant state engineer for the Division of Water Resources, at Sacramento, Calif., has retired after 22 years of state service. He plans to make his residence at Stockton.

George B. Sheldon, Jr., is now chief of the Repair Section of the Public Buildings Service, General Services Administration, Washington, D.C. Formerly Mr. Sheldon was acting director of the P.B.S. Decentralization Division.

Henry E. Helmboldt, lieutenant colonel, Army Corps of Engineers, has been transferred from the First Army Headquarters in New York City, to the Office of the Division Engineer, North Pacific Division of the Corps of Engineers, at Portland, Oreg.

Arthur G. Hayden, of St. Michaels, Md., recently received the honorary doctor of science degree from the Ripon College, at Ripon, Wis. Mr. Hayden was cited as a distinguished alumnus of the college, "renowned for his many accomplishments in the field of structural engineering."

Harold Jolley, senior vice-president for the Ceco Steel Products Corp., in Chicago, Ill., recently completed 35 years of service with the company.

D. B. Steinman, New York City bridge consultant, is now chairman of the U.S. Council of the International Association of Bridge and Structural Engineers.

Wayne Henneberger, formerly design engineer in the bridge division of the Texas Highway Department, at Austin, has reported to the Air Corps for active duty at Kelly Field.

Lowell O. Stewart, head of the department of civil engineering at Iowa State College, has been appointed to the Iowa State Board of Engineering Examiners, succeeding the late **John S. Dodds.**

Damaged—back in service quickly!
Mathews Modernized Hydrants are designed for service even under today's traffic hazards. When knocked over by an out-of-control vehicle their simple construction and removable barrel make them
easier to repair
easier to replace
MATHEWS
HYDRANTS
Made by R. D. Wood Company
Public Ledger Building, Independence Square
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Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Mathews Modernized Hydrants offer these advantages:

Stuffing box cast integral with nozzle section • Head turns 360° • Replaceable head • Nozzle sections easily changed • Nozzle levels easily raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be lubricated • All working parts contained in barrel—removable without excavating • A modern barrel makes an old Mathews good as new • Available with mechanical joint pipe connections

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EASY TO SERVICE

▶ Allis-Chalmers' new tractor line is blazing the way to simpler servicing with time and money savings never before possible.

▶ Adjustments are easier . . . lubrication simplified and lube periods greatly extended. Mechanics say these are the easiest tractors they have ever worked on!

▶ This all adds up to less down time, more producing time...longer tractor life at less upkeep cost.

▶ Following are just a few reasons why this NEWEST, FINEST TRACTOR LINE ON EARTH is *Easy To Service*...besides being built to "take it," easy to operate and entirely new in performance. Get the full story from your Allis-Chalmers dealer.

TIME-SAVING LUBRICATION DESIGN — Only a few lube points, easy to get at — NONE UNDER TRACTORS. You operate *75 HOURS* without any greasing — then only one fitting to hit and an oil change to make. (Only exception, torque converter bearings on HD-20). You lubricate the Positive-Seal truck wheels, support rollers and idlers only once every *1,000 HOURS!*

ACCESSIBLE ADJUSTMENTS — ***QUICKLY MADE*** — brakes, master clutch, steering clutches. No floor plates to remove for any adjustments. Tracks easier to adjust — simple screw adjustment with automatic lock.

EASY TO REPAIR—Engine, master clutch, transmission, steering clutches and final drives can be easily removed and repaired or replaced, *without disturbing adjacent assemblies.*

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The Newest, Finest Tractor Line on Earth!

40.26 drawbar hp.
11,250 lb.

70 drawbar hp.
18,300 lb.

102 drawbar hp.
27,850 lb.

Hydraulic Torque Converter Drive
175 net engine hp.

- DESIGNED FOR YOUR JOB
- BUILT TO "TAKE IT"
- EASY TO OPERATE
- EASY TO SERVICE

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All applications should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Register Now With Your Personnel Service!

The Engineering Societies Personnel Service, Inc., has many outstanding engineering positions available throughout the United States and for foreign service. Make your availability known to the office of the Engineering Societies Personnel Service, Inc., nearest your home. Never before in the 30-year history of the Service has there been greater opportunity for members of the engineering profession in all its branches, mechanical, electrical, civil, mining and metallurgical, chemical, naval architecture, etc. Now is the time to find the opportunity you have been waiting for, but the initial step must be taken by you.—Alfred H. Meyer, Executive Director.

Men Available

ENGINEERING GEOLOGIST; Assoc. M. ASCE; licensed professional engineer; 34, family; 12 years' responsible office and field experience on all types of foundation problems from embankments to power plants; now a technical supervisor; desires position where initiative and technical ability are of prime importance; will consider consulting firm or university attachment. C-687-105-Chicago.

Positions Available

SALES ENGINEERS. (*a*) District Sales Manager, civil engineering degree, for large manufacturing concern in construction materials. Must have experience in contacting engineers and contractors and be a resident of the South. Excellent opportunity. Salary open. Location, Georgia. (*b*) Sales Engineers, 24–40, graduate civil engineers, with some sales experience, to represent above company. Territories, Atlanta, Ga., and Decatur, Ala., and their vicinities. Prefer applicants from the South. Salary open. Y-5566.

HIGHWAY ENGINEER, about 30, registered professional civil engineer with about 5 years' experience in one or more of the following fields: engineering design of pavement and bridges; field construction of pavements; research and test work with a state highway department. Acquaintance with literature on highways and highway construction, including publications of the Highway Research Board and the American Association of State Highway Officials. Position includes inspection of road-test projects, analysis of road-test reports, committee work in connection with preparation of test projects, and advisory assistance to state trucking associations in matters relating to pavements and bridges. Must be willing to travel and to reside in Washington, D.C. Y-5619.

CONSTRUCTION SUPERINTENDENT to take complete charge of erection of large steam electric power station from the foundation until the units are cut in. Salary open. Location, Brazil. Y-5630.

GENERAL CONSTRUCTION MANAGER, graduate engineer, with minimum of 10 years' experience in supervising construction, to follow up scheduled construction jobs in the field. Salary open. Considerable traveling. Location, South America and Europe. Y-5654.

CONSTRUCTION STAFF ENGINEER, 30–45, with up to 10 years' experience, with broad engineering training, to consult and advise on highly specialized engineering problems. Civil degree preferred. Will act as office engineer and resident engineer on industrial plant changes and expansion, large and small projects. Must have broad experience on building construction. Knowledge of equipment erection desirable. Should be able to review structural designs and suggest improvements, make cost estimates, review proposals and advise on letting contracts. Act as company representative on projects away from home office. Traveling involved. Salary to start, $5,400–$6,300 a year. Location, New Jersey. Y-5656.

CONSTRUCTION ENGINEERS for dam construction project. Must have had considerable experience in their respective capacities on construction of dams. (*a*) Design Engineer for powerhouse. (*b*) Design Specialist for high dams. (*c*) Mechanical Engineers. Write stating qualifications and experience, and salary requirements. Living quarters with electricity and water supply available. Location, India. Y-5666.

CHIEF ENGINEER, 35–50, Mechanical or Civil Engineer, with at least 10 years' design experience covering heavy industrial cranes, to supervise design engineers and draftsmen for well-established firm manufacturing custom-built heavy handling equipment and industrial buildings. Salary, $9,000–$12,000 a year. Location, Northwest. Y-5685.

ENGINEERS. (*a*) Sales Manager, 38–55, college graduate; registered engineer, with several years' sales or management experience with a recognized engineering or construction organization, selling and negotiating engineering or construction contracts with industrial plant owner and government agencies, domestic and foreign. Salary, about $12,000 a year. (*c*) Manager of Engineering and Construction, 38–50, graduate, with heavy engineering/construction experience representing the bulk of his working career. Will head up the entire operations division of a sizable industrial engineering and building concern, reporting directly to the vice-president. Salary, $12,000–$15,000 a year. Location, New York, N.Y. Y-5712.

SALES ENGINEER; civil graduate, preferably with some highway experience, although a recent graduate will be acceptable, to train for selling bituminous and asphalt materials. Several territories open in the East. Salary to start, $3,600 a year. Y-5742.

JOB ENGINEER, civil, who has had considerable experience on heavy construction for project that will include piers, powerhouse, railroad, etc. Possibility of taking family at later date. Salary, $9,600–$10,800 a year. Location, Chile, at sea level. Y-5755.

PROCUREMENT ENGINEER, preferably civil, to purchase materials from manufacturing supply houses for construction of hospital and other public buildings for a foreign country. Experience in contracting office desirable. Location, New York, N.Y. Y-5761.

RESIDENT ENGINEER, civil graduate, to supervise construction of a 200-bed hospital of re-

(*Continued on page 88*)

HYDRO-ELECTRIC DESIGN ENGINEER

Graduate Civil Engineer with minimum five (5) years' experience design hydro-electric structures (Dams, Intakes, Tunnels, Canals, Penstocks, Power Houses, etc., and preparation of construction drawings) required by an established public utility service organization. Location New York. Attractive salary. Splendid opportunity for right man. Write giving age and fullest details of qualifications and experience.

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Box 200
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RESEARCH OPPORTUNITY

Graduate in engineering for research and development problems in fluid flow involving water, air and steam. Man with several years of experience in experimental techniques and laboratory procedure is desired. Well equipped laboratory located in Ohio. Send complete details of education and experience in communication to:

Box C. E. 197
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MATERIALS RESEARCH OPPORTUNITY

Graduate in physics or metallurgical engineering needed for study of material properties under simulated service conditions of stress, temperature, atmosphere, etc. Knowledge of materials properties and experimental testing techniques important. Well equipped laboratory in Ohio. Send complete details of education and experience in communication to:

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RESEARCH STRESS ANALYST

For projects involving stress and strain measurements. Experience in experimental research techniques using strain gages, brittle lacquers, etc., is desirable. Work is primarily on pressure vessels, heat exchange equipment, and the study of materials for such service. Knowledge of theoretical stress-strain relationships also desirable. Well equipped laboratory located in Ohio. Send complete details of education and experience in communication to:

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New Publications

Educational Defense Programs. Issuance of a summary report on the *Defense Programs of Selected Federal Agencies Affecting Colleges and Universities* is announced by the Board of Control for Southern Regional Education. The report is available at 40 cents for single copies and 30 cents for lots of ten or more. Orders should be mailed to the Board of Control for Southern Regional Education, 830 West Peachtree Street, Atlanta, Ga.

Water Pollution. An investigation of sea-water intrusion into ground-water basins bordering the California coast and inland bays is detailed in Report No. 1 of the Division of Water Resources of the California Department of Public Works. Present laws relating to prevention and control of sea-water intrusion are also discussed. Inquiries should be addressed to the State of California Department of Public Works, Division of Water Resources, Sacramento, Calif.

Structural Research. Availability of two recent University of Texas structural research bulletins is announced by the Bureau of Engineering Research. They are Circular No. 13, *Equilibrium Equations Without Restraining Forces for Moment-Distribution-Sway Problems* by Phil M. Ferguson, and *The Statics Ratio for Analysis of Frames that Deflect* by Phil M. Ferguson and Ardis White, in Engineering Research Series No. 45. Copies may be obtained from the Bureau of Engineering Research, University of Texas, Austin 12, Tex.

Water Poulution. The basic facts of our water pollution problem—how and where it originates, and what steps are needed to control it—are presented in Public Health Service Publication No. 64, *Water Pollution in the United States.* Information has been assembled with the cooperation of state and interstate water pollution control authorities and federal agencies. Copies may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 35 cents each.

Mississippi River Flow. Detailed stream-gaging records for the lower Mississippi Valley for 1949 are available in *Stages and Discharges—Mississippi River and Its Outlets and Tributaries, 1949*, compiled by the President's Office, Mississippi River Commission, Corps of Engineers. Copies may be purchased at $1 each from the Office of the President, Mississippi River Commission, Corps of Engineers, Vicksburg, Miss. Checks or express money orders should be made payable to the Treasurer of the United States.

Pollution Control. In an effort to create a more uniform state pollution control program by legislation at the state level, the Division of Water Pollution Control of the Public Health Service has assembled a text entitled *Suggested State Water Pollution Control Act and Explanatory Statement.* Inquiries should be addressed to the Federal Security Agency, Public Health Service, Division of Water Pollution Control, Washington, D.C.

Timber Research. Issuance of an eight-page booklet entitled *Standard Specifications for the Design and Fabrication of Structural Glued Laminated Lumber*, developed by the Forest Products Laboratory of the Forest Service, is announced by the West Coast Lumbermen's Association. The publication may be obtained without charge from the West Coast Lumbermen's Association, 1410 S.W. Morrison Street, Portland 5, Oreg.

Steel Research. Continuing publication of its series on steel and steel products, the American Iron and Steel Institute now makes available Section 21 on "Concrete Reinforcing Bars." The Bulletin sells for 25 cents from the Institute, 350 Fifth Avenue, New York 1, N.Y.

Technion Yearbook. Closer ties between America and Israel "through science and industry" are stressed in the *Technion Yearbook* for 1950. Edited by Judah Wattenberg, the 356-page volume, ninth of a series, presents 28 original articles and illustrations on science and technology. Authors include Dr. Harry S. Rogers, M. ASCE, president of Brooklyn Polytechnic Institute. For further information write to the American Technion Society, 154 Nassau Street, New York 38, N.Y.

Structural Design. Investigation of the problem of dynamic oscillation in suspension spans, conducted for the Advisory Board on Investigation of Suspension Bridges following the collapse of the Tacoma Narrows Bridge, are detailed in a publication of the Bureau of Public Roads, entitled *The Mathematical Theory of Vibration in Suspension Bridges.* The authors are Richard Rosecrans, George S. Vincent, the late C. B. McCullough, and the late Friedrich Bleich. Copies are available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at $1.25 each.

Water Treatment Equipment. A bulletin of photographs, drawings and descriptions of various types of *Dorrco Hydro-Treators*, as well as information on operating results, capacity ratings, chemical dosing requirements, and four pages of tables and formulas commonly used by engineers, is now being distributed by the Dorr Company. Inquiries should be addressed to the company at Barry Place, Stamford, Conn.

Production Controls. Publication of a new weekly "Controls Service" indexing and digesting new price, and production and distribution regulations, has been initiated by *The Journal of Commerce.* This new service consists of master editions of an all-inclusive "Controls Guide" at six-week intervals, and weekly "Bulletin Summaries" designed to keep each master edition constantly up-to-date. Subscriptions to the service are available at $25 a year from the *New York Journal of Commerce*, 63 Park Row, New York 15, N.Y. Master editions of the "Controls Guide" are $1 each.

River Investigations. Flow of the Missouri River for the 53-year period ending with 1949 has been compiled by Guy C. Stevens and Clayton H. Hardison in Circular 108 of the U.S. Geological

(*Continued on page 90*)

Positions Available

(*Continued from page 86*)

inforced concrete and steel. Some knowledge of heating, plumbing and supervision of contractors desirable. One to two years' foreign employment. Y-5762.

ESTIMATOR, Civil Engineer, about 40, with 10 years' minimum experience for contractor on industrial, commercial and institutional buildings. Knowledge of current prices and costs. Will estimate for contractor. Good opportunity. May work into partnership arrangement. Salary, $7,800 a year plus bonus. Location, Chicago, Ill. R-7919.

CIVIL ENGINEER, graduate, 30–50, to manage construction, operation and maintenance of company-owned lumber mill town of 2,500 population. Must be capable of designing and laying out new section and supervising construction. Thorough knowledge of water and sewage systems required. Salary open. Location, southwestern United States. S-1159.

FOR YEARBOOK DATA. Please supply *all* information requested.

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Meetings and Conferences

American Institute of Electrical Engineers. Headquarters for the Pacific general meeting of the American Institute of Electrical Engineers will be the Multnomah Hotel, Portland, Oreg., August 20–23.

British Engineers' Association. An engineering, marine, and welding exhibition, sponsored by the British Engineers' Association, will be held in London, England, August 30 through September 13.

Conference on City and Regional Planning. The thirteenth annual Conference on City and Regional Planning will take place at the Massachusetts Institute of Technology, September 4–18. Inquiries should be addressed to Prof. Burnham Kelly, Room 7-335, Massachusetts Institute of Technology, Cambridge 39, Mass.

Conference on Prestressed Concrete. The first United States Conference on Prestressed Concrete will be held at the Massachusetts Institute of Technology, August 14–16. Co-sponsors are the American Concrete Institute, American Institute of Architects, American Railway Engineering Association, American Society of Civil Engineers, Associated General Contractors of America, and the Portland Cement Association. Further information and registration forms may be obtained from Prof. Myle J. Holley, Jr., Department of Civil Engineering, Room 1-230, Massachusetts Institute of Technology, Cambridge 39, Mass.

Illuminating Engineering Society. Latest advances in lighting research will be discussed at the national technical conference of the Illuminating Engineering Society, at the Hotel Shoreham, Washington, D.C., August 27–30.

Instrument Society of America. Headquarters for the sixth national conference and exhibit of the Instrument Society of America will be the Sam Houston Coliseum, Houston, Tex., September 10–14.

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New Publications

(*Continued from page 88*)

Survey. In addition to flow for the six long-term locations, the report contains a compilation of all discharge records published by the Geological Survey for gaging stations on the Missouri River between Fort Benton, Mont., and Hermann, Mo., and for the most downstream station on 18 of the principal tributaries. Copies may be obtained free on application to the Director, U.S. Geological Survey, Washington 25, D.C.

Hydraulics. A hydraulics primer for supervisors, foremen, and others with position of responsibility in the water works industry has been prepared by Robert J. Sweitzer. Inquiries regarding the publication, which is entitled *Basic Hydraulics for Water Works Operators*, should be sent to the American Water Works Service Co., Inc., 121 Broad Street, Philadelphia 7, Pa.

Defense Production. Week-by-week developments in defense production will be summarized in a bulletin initiated by the Defense Production Administration. Entitled *Defense Production Record*, the weekly bulletin will be free to newspapers and trade publications. Business firms and other organizations may obtain the publication for $2.50 a year ($4 foreign) from the Superintendent of Documents, Government Printing Office, Washington, D.C.

Railroad Classification. The railroads of the country have been classified according to capacity and relative importance in a comprehensive railroad map prepared by Edward L. Ulman, associate professor of regional planning at Harvard University. The map shows trackage (multiple or single), electrification (exclusive of most interurban lines), and traffic control and signal systems. Copies may be obtained from the Simmons-Boardman Publishing Corp., 30 Church Street, New York, N.Y., at $2.50 each.

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CASAGRANDE, LEO, Cambridge, Mass.
CLASS, MAURICE MORRISSEY, Tokyo, Japan.
ENDE, CARL FREDERICK, Marble Falls, Tex.
ENGEBRETSON, WILBUR C., Honolulu, Hawaii.
JOHNSON, WILLIAM EDWARD, Jackson, Miss.
MELISSINOS, KIMON SPYROS, Athens, Greece.
NEWELL, JOHN NEWMAN, Kansas City, Mo.
PETRIE, BENJAMIN RUSSELL, Indianapolis, Ind.
PETERSON, CLARENCE ARTHUR, Sarasota, Fla.
PHILO, CLIFFORD ALLAN, Kansas City, Kans.
SHAMBERGER, HUGH ALLAN, Carson City, Nev.
SPECTOR, HARRY, Brooklyn, N.Y.
THORPE, ELMER HANCOCK, Newark, N.J.

Applying for Associate Member

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BROWN, CLARENCE CHRISTIAN, Huntington, W. Va.
CARO COSTAS, SALVADOR VENTURA, San Juan, Puerto Rico.
HIRSCH, EDMUND, Milwaukee, Wis.
LEECH, THOMAS DAVID JAMES, New South Wales, Australia.
MAGRATH, FREDERICK NEALE, JR., New York, N.Y.
MARION, JOSEPH LINCOLN, Philadelphia, Pa.
OKUBO, SHIGEO, Honolulu, Hawaii.
RODGERS, POLLARD, El Paso, Tex.
SINGER, ALVIN CHESTER, Kansas City, Mo.
SANDOZ, MARCEL HENRY, Princeton, N.J.
VASS, DAVID THORBAN, Plattsburg, N.Y.

Applying for Junior Member

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CANNON, JAMES ROBERT, San Francisco, Calif.
DAWWAT, YOUSIF, Baghdad, Iraq.
FABREGA, VICTOR JOSE, JR., Panama, Panama.
HARGREAVES, WILLIAM VERN, Salt Lake City, Utah.
HARTER, MARION MONROE, Leavenworth, Kans.
JACOBS, WARREN IRWIN, San Francisco, Calif.
KILLORAN, CLARENCE HENRY, Niagara Falls, Ont., Canada.
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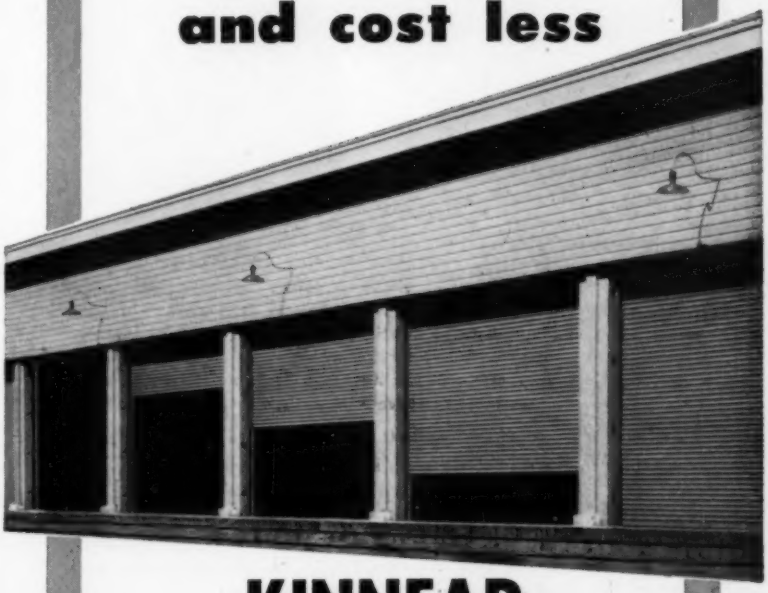

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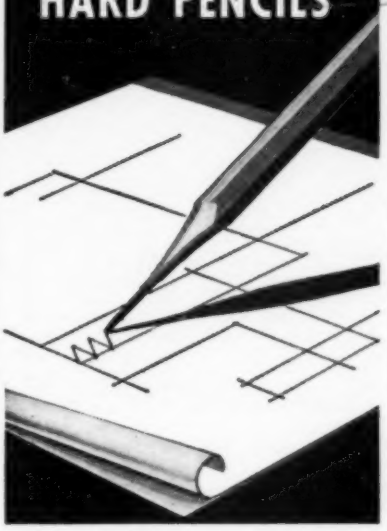

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Ripping Attachment

RIPPING ATTACHMENTS for bulldozers and carry-alls, permitting ripping and dozing in the same operation, are being manufactured. The Hensley rippers are available in twelve models to fit all standard bulldozers and scrapers. They increase speed and efficiency of brush and rock removal for construction and maintenance of roads, fire lanes and all operations requiring dozing. Eliminating the need for heavy ripping assemblies—expensive to transport to remote operation points—the rippers are easily trans-

Available in Twelve Models

portable, attach quickly and are strong enough for any job. The ripper shanks are attached to the bulldozer blades in a matter of minutes. On the back of each shank is an I-bolt, which is fastened to a small bracket which is welded to the back of the blade. The rippers have reversible wear boots, which because of their special alloy content, are extremely resistant to wear and abrasion. The boots are self-sharpening. As soon as one side is worn, the boot may be reversed and used again. The Hensley rippers will dig to a depth of 12 in. in one pass if there is not an excessive amount of rock in the surface. When a large amount of rock or shale is encountered, adequate ripping action can usually be obtained in two 6-in. passes. **Hensley Equipment Co., 878 Joaquin Ave., San Leandro, Calif.**

High Detergency Oil

A high detergency oil has been added to the line of Gulfpride oils. The product has the ability to minimize engine deposits, clogged oil rings, sludge formation, rust and wear in gasoline engines, particularly in "stop-and-go" service. Gulfpride H.D. oils possess high viscosity indices and low pour points, insuring ease of starting and immediate flow of oil to bearing surfaces in cold weather. Low oil consumption and the maintenance of adequate body under high temperature, high speed driving conditions are assured by the high viscosity indices and the low volatility characteristics. **Gulf Oil Corporation, Pittsburgh, Pa.**

Pile Hammer

THE DEVELOPMENT of a new size and model of double-acting pile hammer is announced. The hammer, known as the No. 6.5, was designed primarily for driving steel sheet piling in close quarters. It is capable of driving one pile between two adjacent sheets, and is ideal for driving in sand. It normally operates at 280 blows per minute, with an energy of 3200 ft lbs per blow, and is suitable for 8 in. to 15 in. steel sheet piling or 6 in. by 12 in. wood sheeting or the equivalent size of round timber piles. Ask for Bulletin 58-A. **McKiernan-Terry Corporation, Dept. 101, 15 Park Row, New York 38, N. Y.**

Lifting and Loading Boom

A HEAVY-DUTY BOOM, designed especially for lifting and loading with the 5 ton truck-mounted Bantam shovel-crane, has just been announced. Available in 25 ft length, with 5 ft extensions, the boom has approximately 4 times more rigidity than standard booms, due to use of heavier reinforcing and bracing to resist shock and sling load conditions. Approximately 200 lbs more steel strength is achieved with

Heavy-Duty Boom

heavy duty angles, together with additional braces along the lower section for protecting boom when dropped or bumped against other objects. The boom is especially adaptable for logging operations, pipe handling, steel erection, industrial materials handling, etc., thus increasing the work range of the truck-mounted Bantam, which is also available with shovel, trench hoe, back filler dragline, pile driver, magnet and clamshell attachments. The crane is conservatively rated at 10,000 lbs capacity at 10 ft with outriggers and 1000 lb counterweight. **Schield Bantam Company, Waverly, Iowa.**

Cement Distributor

A TWO-WHEELED RUBBER-TIRED cement distributor for use with either bulk cement trucks or sack cement, has been introduced. The distributor is attached directly behind the cement truck. Cement is dumped into the hopper on the distributor and by means of a calibrated rotary vane is metered on to the windrow. The windrow is automatically troughed by an axle-high V-spreader on the front of the distributor, which protects the cement from blowing. The cement distributor has an adjustable

One-Man Operation

capacity of 15 to 80 lbs per lineal ft. It is easily attached to the truck and can be maneuvered on the job by one man. **Wood Manufacturing Co., Box 620, 6900 Tujunga Ave., North Hollywood, Calif.**

Translucent Drawing Paper

A TOUGH, DURABLE, and highly translucent drawing reproduction paper called Kodagraphautopositive paper, translucent, is now being distributed. Designed to meet exacting requirements in the drawing copy field, the paper is coated with the same emulsion used on regular Kodagraph autopositive paper. The paper on which the emulsion is coated, however, is considerably tougher. It will withstand longer and rougher handling without tearing. This assures greater life on the drafting board and in the reproduction department. Another feature is the ease with which drawing changes can be effected. Lines erase readily when moistened. The paper can be handled on familiar reproduction equipment and in ordinary room light. It results in blackline prints from original drawings. The quality of these prints often represents an improvement over the originals. As a result of its greater translucence, blueprints and direct process prints can be turned out up to 30% faster. Furthermore, details printed on the paper can easily be read through the back of the sheet. As a result, reverse-reading autopositive, translucent intermediates are easy to work on. **Eastman Kodak Co., Editorial Service Bureau, Rochester 4, N. Y.**

Equipment, Materials & Methods (Continued)

Aerial Photo Rule

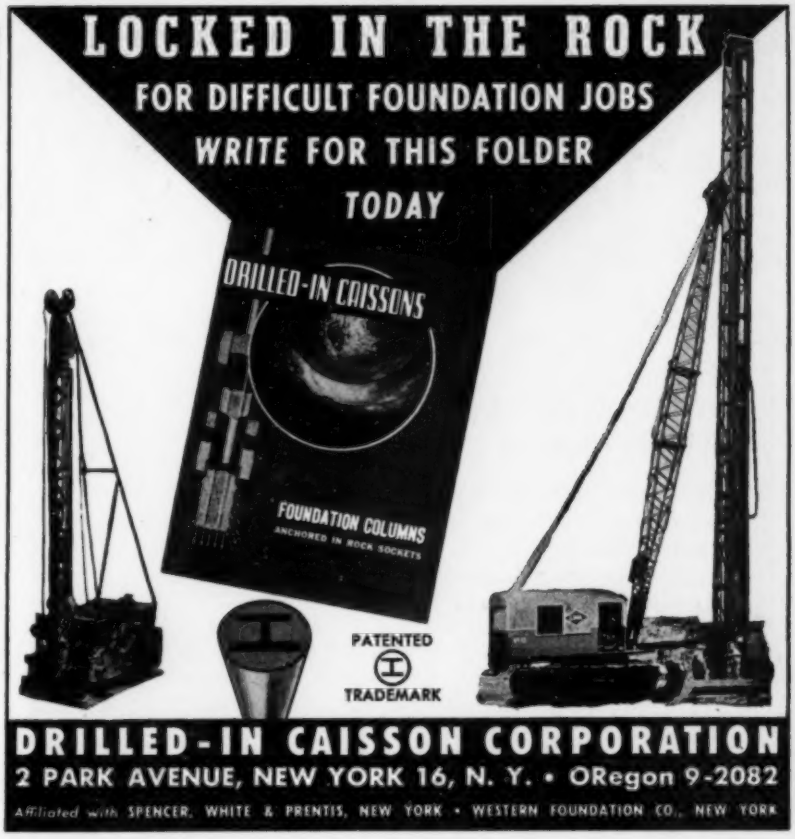
THE AERIAL PHOTO RULE, without reference to tables and old style calculations, by means of five simple scales gives instant answers to types of problems like these: comparative size between objects on the ground and in a photograph; the area of land covered by one exposure of film at a

Double-Purpose Rule

given focal length, altitude and film size; ground feet covered in flight per inch of photograph; speed at which image moves under camera lens; cycling time or exposure time in seconds required to cover image while plane flies at so many miles per hour, at a given height with camera set at a given focal length. Also, if the object is a certain size on photograph, the rule gives actual size on the ground and determines the minimum altitude at which a plane must fly at a given exposure time to give adequate coverage on film. Designed as a double-purpose rule, it bears on one side an altitude scale, a focal length scale, two image size scales, one reading in feet and one in centimeters, and a ground size (feet scale) for settings in either mph or knots. On the reverse side the rule bears L, A, DF-CF, CIF, T, S, C-D, DI, K for general computations. It is made of non-warp light metal, has a white surface with needle-sharp black graduations. Boxed complete in leather case with manual in two sizes, 6 and 10 in. **Pickett & Eckel, Inc., 5 South Wabash Ave., Chicago 3, Ill.**

Towing Vehicle

SPECIAL TOWING VEHICLES called Mules are being used to tow giant B-36 bombers around air force bases all over the world. The Mule is powered by a 150 hp gasoline engine. It weighs 35,000 lbs and has a six-man cab. It is completely winterized to allow operations at 65 deg below zero. At the same time, the vehicle has a large, over-size cooling system to permit operation in extremely high temperatures up to 130 deg. The hydraulic booster system for the four-wheel steering gives the Mule finger-tip maneuverability and a turning radius of only 20 ft. The Mule with its Coleman patented wheel assemblies has ample tractive power to pull the world's largest bombers. **American-Coleman Company, Omaha, Nebraska.**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CEMENT GUN COMPANY RELINES SETTLING BASINS WITH GUNITE

Photograph above shows three of four Settling Basins at a Virginia City's Municipal Water Works during the course of being relined with "Gunite." The concrete in this structure had disintegrated considerably, due to chemical and frost action.

Cement Gun Company crews replaced a "Gunite" lining on the floor and on the exterior walls of the basins and, in addition, grouted under the floor of all four basins to solidify the structure.

Additional reinforcing of steel mesh and "Gunite" was added at all corners where failure was indicated by leakage and the presence of large cracks.

This is just one of many typical "Gunite" repair jobs which have been done. For information on "your job" and description of many other "Gunite" jobs performed by us, send details and request catalog (B)2400—on your letterhead, please.

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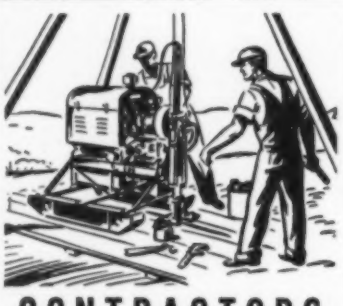

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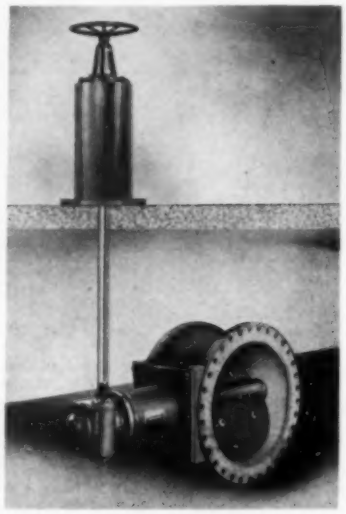
Equipment, Materials & Methods (Continued)

Manual Control Valve

HEAVY-DUTY VALVE No. 788 is equipped with totally enclosed gear reduction drive, extended shaft and floor stand. The sealing of water pressure is obtained by utilizing a babbitted seat in the body and Monel or stainless steel welded to the periphery of the valve disc. Such metal-to-metal seat gives satisfactory commercial shut-off in most installations. For instance, with a 350 ft head of ambient water, a 36-in. valve with a babbitted seat has a leakage of only 50 ghp. Remote, automatic or semi-automatic controls are also available for this type of valve. Manufactured by **R-S Products Corporation, 4600 Germantown Avenue, Philadelphia 44, Pa.**



Valve No. 788

Terratrac

A VERSATILE CRAWLER TRACTOR called the GT 30 Terratrac is being introduced. The multi-purpose tractor is powered by the four cylinder Continental F-140 engine and includes other well-known standard parts. It is designed for a wide range of construction and industrial applications. When fully equipped with hydraulically activated bulldozer and angle dozer, the GT 30 weighs less than 4,400 lbs. This light weight means it must move only about half the weight of other crawlers in its horsepower class. By using its second speed of 3 mph in most operations, the Terratrac accomplishes with speed and impact what much larger tractors do with weight and creeper speeds. Special rubber track shoes have been developed for this

(*Continued on page 97*)

"WORK-TEAM"
of the
Irrigation Industry

For heavy production at extra low cost, Layne built wells and Layne vertical turbine pumps are the most widely used work-team of the irrigation industry. Capable of producing great quantities of water at an extra low cost, they make irrigation with well water a profitable business.

They are exactly the same kind of wells and pumps Layne installs for cities, factories, railroads and other big users of well water. They have the same unmatched features of high efficiency, dependability and extra long life. No other make is so widely used or so thoroughly proven. No other is so low in upkeep.

•

WELL WATER SYSTEM CATALOG

Fifty-two pages of vitally interesting and helpful information on the Layne method of building well water systems. Contains sections on special drilling, shutter screens, vertical turbine pumps and engineering tables. A copy will be sent on request. Please use your company letterhead.

LAYNE & BOWLER, INC.
General Offices Memphis 8, Tenn.

Layne
WATER SUPPLY
WELLS & PUMPS

tractor, permitting it to take advantage of its 4.98 mph third speed. These shoes increase the uses of the GT 30 and its speeds for indoor operations on cement or wood floors, as well as on all types of highways. Interchangeable gauge widths ranging from 42 to 72 in., the use of five lower track rollers, and more than twice the ground

GT 30

clearance of most other crawlers, give the Terratrac extra stability in hilly, sandy or muddy terrain. In addition to the bulldozer and angle dozer, hydraulically operated attachments include bucket loaders, winches, scoops and others. Of special interest is a three-point hydraulic lift system for rear mounted tools. Wide arm rests, upholstered seat, conveniently located controls, full visibility from all sides and well guarded leg space give operators additional comfort and add to the maneuverability of the Terratrac. **American Tractor Corporation, Churubusco, Ind.**

Diamond Blades

THE KNOWN CUTTING qualities of the diamond have now been successfully adapted to the cutting of concrete and asphalt. Streets, building floors, drives, walks, runways, etc., are cut with ease with Clipper diamond blades and a Clipper concrete saw. The concrete cutting diamond blades are in addition to the 36 specifications of diamond blades especially designed for the cutting of hard-vitreous materials (glazed tile, brick, glass block, marble, etc.) on masonry saws. Concrete containing limestone aggregate can be sliced up to 10 ft per minute when cutting a depth of 1 in. Asphalt containing the same aggregate, and cut to the same depth, can be sliced at the rate of 12 ft per minute. Specifications of (concrete) diamond blades are available for all types of aggregate and age of concrete. These blades are manufactured in diameters from 8 in. to 18 in. and in thicknesses of $^{5}/_{32}$ in. to $^{7}/_{64}$ in. for use on any type concrete saw. **Clipper Manufacturing Company, 2800 Warwick, Kansas City 8, Mo.**

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Koppers Posts are made from sound, strong wood. They are pressure-treated with creosote to protect them against decay and termites. The pressure-treatment method is identical with that used by Koppers to protect utility poles, foundation and marine piles, and the timber in highway bridges. Koppers Posts give decades of service, making them extremely economical. They require no painting, and they never rust.

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Koppers Posts, when treated with creosote, have a dark, warm color. They blend nicely with most surroundings. However, if you prefer wood posts that are easily paintable, Koppers will use a preservative other than creosote.

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Equipment, Materials & Methods (Continued)

Hydraulic Jack

THE SIMPLEX ROL-TOE, a 25 ton capacity hydraulic jack of a new design, is announced. The outstanding feature is that the lifting toe capacity is identical to the lifting capacity on the cap. The toe rides on a bearing roller that carries the radial head against a stationary ram's flat-milled surface. The whole lifting operation is smoother and easier because the broad $4^1/_2$ in x $4^1/_2$ in. toe always remains in an even position. The Rol-Toe, Model RTJ-25, has a 7 in. lift, with minimum heights of $2^1/_2$ in. when lifting on the toe and 14 in. when lifting on the cap. Other benefits are the fact that the ram does not travel—the sturdy integral construction of the head toe shortens off center loading and brings the toe closer to the center of the ram. Equal efficiency is obtained in an upright or horizontal position. The oil reservoir is independent of the load-lifting housing to eliminate pressure stress and prevent oil leakage. The Rol-Toe has two separate pumps—a high speed pump for positioning and lifting lighter loads and a high pressure pump for heavy lifting. A safety by-pass valve, set well over rated capacity, is provided to guard against over-loading. Ask Hydraulic Bulletin 51. **Templeton, Kenly & Company, 1020 South Central Ave., Chicago 44, Ill.**

Ultra-Violet Sterilizer

AN ENTIRELY AUTOMATIC, electrically operated ultra-violet water sterilizer now solves the problem of supplying pure drinking water for farms, motor courts, rural and suburban homes, etc., or wherever water must be obtained from a well, spring or other unprotected sources. Known as the Sepco ultra-violet water sterilizer, the device meets public health standards for pure drinking water. It requires no attention, uses no chemicals and adds no taste or odor to the water. Purification is done by powerful ultra-violet radiation utilizing the same principle frequently employed for atmospheric purification in laboratories, hospitals and other places where the air must be free of germs. Basically, the sterilizer consists of a stainless steel tank 72 in. high by 12 in. in diameter. Inside are four specially constructed ultra-violet ray tubes extending vertically through the water. Patented baffles at various levels guide the incoming water close to the constantly glowing tubes, thus assuring complete destruction of dangerous bacteria. The sterilizer purifies water at the rate of 400 gph; more than the average home will use in an entire day. Where a larger supply of water may be needed, two or more sterilizers can be installed. Installation is quick and inexpensive. It is only necessary to connect the sterilizer into the incoming water line ahead of any taps, then plug it into a standard electrical outlet. **Sepco Corporation, Pottstown, Pa.**

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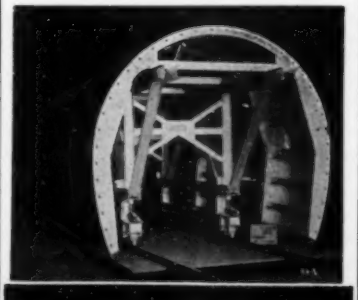

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Literature Available

CALCIUM CHLORIDE—Brief SB-2 "Calcium Chloride for Unpaved Roads" describes proper procedures for using calcium chloride. On aggregate surfaced roads, it will reduce dust and conserve material, plus giving advantges of lower maintenance costs and all-weather surfaces. **Calcium Chloride Association, 909 Ring Bldg., Wash., 6, D.C.**

TANDEM ROLLER—A catalog on the model 3-5 ton variable weight tandem roller has just been issued. The many improvements in construction and operation are fully described and illustrated. Complete specifications are also listed. **The Galion Iron Works & Mfg. Co., Galion, Ohio.**

PUMP MOTORS—E-M Synchronizer No. 33, deals with large pumps and the application of a-c motors to them. The two color, 24-page booklet, fully illustrated throughout contains much helpful engineering information, charts and diagrams, plus photographs of many of the pumping installations in the country. **Electric Machinery Mfg. Company, Minneapolis 13, Minn.**

DIESEL ENGINES—Four 2-page folders presenting operating and construction features of International diesel engines are being distributed. These folders offer detailed information on reserve torque control, all-weather gasoline conversion starting, combustion control, and long-life lubrication. **Industrial Power Division, International Harvester Company, 180 North Michigan Ave., Chicago 1, Ill.**

DRAGLINE BUCKETS—Catalog No. 188 entitled, "ESCO Dragline Buckets for Every Digging Condition," illustrates and gives specifications for all five types of ESCO draglines. Specifications are given in easy to read detail and are illustrated with a model view of the representative bucket. Packed into eight concise pages you will find the bucket ESCO has designed to do your job. Recommendations are given with each set of specifications. **Electric Steel Foundry Company, 2141 N.W. 25th Ave., Portland 10, Ore.**

WINCH MANUAL—Emphasizing the importance of equipment care and maintenance in the national mobilization program, a 12-page operator's guide and general information for the Hyster D7N towing winch designed exclusively for the Caterpillar D7 diesel tractor, has just been issued. Liberally illustrated with photos and drawings, the manual takes the operator from fundamental instruction through various problems encountered on jobs under certain circumstances in the woods or on difficult terrain. Ask for Form No. 1184. **Hyster Company, 2902 N. E. Clackamas St., Portland 8, Ore.**

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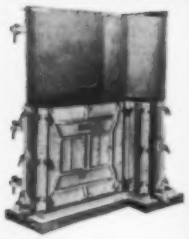

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Literature Available (Continued)

MOTOR BULLETIN—Bulletin 05B7150A, describes types of construction and ratings of improved totally enclosed, fan-cooled motors with tube-type, air-to-air heat exchangers. A chart shows ratings of the motors available in squirrel-cage, wound-rotor and synchronous types for both horizontal and vertical installation, and a cross section view of horizontal motor construction features. **Allis-Chalmers Manufacturing Company, 1187 S. 70th St., Milwaukee, Wis.**

CHAIN DRIVES AND CONVEYORS—A bulletin entitled "Installation, Operation and Maintenance of Chain Drives and Conveyors" has just been published. The bulletin shows how to get the most service from your sprocket chains. Illustrations show graphically the correct and incorrect ways of solving chain installation, operation and maintenance problems. Request Bulletin No. 51-7, **Chain Belt Company, 1600 West Bruce St., Dept. PR, Milwaukee 4, Wis.**

MASTIC FLOORING UNDERLAYMENTS—A 4-page folder on "Mastic Flooring Underlayments" which includes both asphalt and rubber types has just been issued. The composition and mixtures for asphalt emulsion and rubber latex binders are described together with recommended practice in application. **The Industrial Products Division of the Flinkote Company, 30 Rockefeller Plaza, New York 20, N. Y.**

PLASTIC SURFACED PLYWOOD—The first catalog folder on plastic surfaced plywood has been issued as a reference manual and describes the types of plastic surfaced Douglas fir plywood, properties of the overlay panels and some of the countless applications in building and industry. Also included are recommendations for use of the new premium-surface panel material which combines all the desirable properties of fir plywood and plastics. **Douglas Fir Plywood Association, Tacoma 2, Wash.**

WALL FORM CONSTRUCTION—A 34-page catalog on a system of wall-form construction is announced. Incorporated in the catalog is all of the latest information and improvements in the Symons forming system. Illustrations show in detail how simply and easily the forming system operates. Actual jobs where forms have been used are well illustrated—showing the form in use as well as completed foundations. Also, blueprint illustrations and complete specifications are given—material and equipment necessary, time required and cost figures on actual jobs. By sending in plans and specifications, you will be furnished a free form layout of your job without charge or obligation. **Symons Clamp & Mfg. Co., 4249 Diversey Ave., Chicago 39, Ill.**

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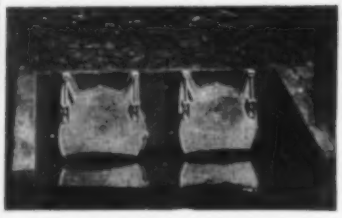

Fig. B-124-D
Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

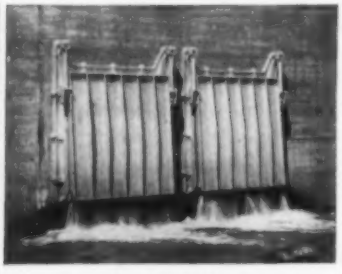

Fig. B-124-C
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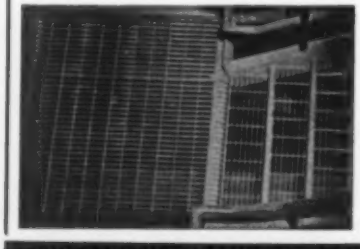

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Literature Available (Continued)

AIR ENTRAINMENT—"What Air Entrainment Means to You," is the name of a leaflet which gives the boiled-down facts about the advantages of air entrainment in concrete. Write to **Dumpcrete Division, Maxon Construction Company, Inc., 131 North Ludlow St., Dayton 2, Ohio.**

GASKETS—Engineering specifications for use of Hexseal rubber gaskets with reinforced concrete sewer pipe are contained in a brochure. Among the subjects covered by the text and drawings are: type of pipe, dimensions, pipe design, steel reinforcement, concrete, water curing, steam curing, curing compounds and curves. A special section discusses installation instructions. **Universal Concrete Pipe Co., 297 South High St., Columbus, Ohio.**

TRACTOR EQUIPMENT—A catalog, Form No. 1106, covering a complete line of tractor equipment has been published. Products described and illustrated include traxcavators, pipe layers, earth augers, swing cranes and land clearing equipment. Specifications are included for each unit. **Trackson Company, Dept. P., Box 728, Milwaukee 1, Wis.**

CLAY PRODUCTS—A condensed 4-page bulletin of particular interest to architects, contractors and builders has been published. Printed in two colors, the bulletin details and illustrates a broad range of clay products. Condensed specifications are provided for vitrified clay pipe, perforated clay pipe, staminite pipe, etc. **A. E. Williams, The Robinson Clay Product Company, Akron, Ohio.**

THE PHOSCOTE PROCESS—An 8-page booklet entitled "The Phoscote Process" contains information on the pickling and painting of steel plates, angles, channels and other shapes produced by rolling. The booklet contains photographs and drawings showing the various operations during the Phoscote process. Also, photographs of complete structures which have been built of plates and shapes treated by the process, are included. **Chicago Bridge & Iron Company, Chicago 4, Ill.**

MULTI-PLATE UNDERDRAIN SYSTEM—A folder describing the Layne multi-plate underdrain system has just been released. Multi-plates channel the upflow horizontally when backwashing a water purifying plant. These baffle plates are made from stainless steel to exacting dimensions. The booklet is illustrated with cutaway sections and a typical installation shows the even water distribution and non-clogging features of the multi-plate. **Layne & Bowler, Inc., Memphis 8, Tenn.**

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PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 104.

Summarized in Earlier Issues

61. Structural Damping in Suspension Bridges, by the late Friedrich Bleich and L. W. Teller.

62. The New Towns Program in Great Britain, by T. C. Coote.

63. National Geodesy—Status and Planning, by Leo Otis Colbert.

D-8. Discussion of Paper, **Floating Tunnel for Long Water Crossings,** by Charles E. Andrew.

D-11. Discussion of Paper, **Long-Term Storage Capacity of Reservoirs,** by H. E. Hurst.

D-16. Discussion of Paper, **Pavement Bearing Capacity Computed by Theory of Layered Systems,** by Guthlac Wilson and G. M. J. Williams.

D-19. Discussion of Paper, **Flood-Control Operation of Tennessee Valley Authority Reservoirs,** by Edward J. Rutter.

D-23. Discussion of Paper, **Influence of Heavy Loads on Pavement Design Trends,** by K. B. Woods.

64. Planning the National Capital: Objectives and Problems of Attainment, by Ulysses S. Grant III.

65. National Topographic Mapping, by W. E. Wrather.

66. Lateral Forces of Earthquake and Wind, by a Joint Committee of the San Francisco, Calif., Section, ASCE, and the Structural Engineers Association of Northern California.

D-13. Discussion of Paper, **Reinforced Concrete Skewed Rigid-Frame and Arch Bridges,** by Maurice Barron.

D-18. Discussion of Paper, **Successive Approximations for Beams on an Elastic Foundation,** by E. P. Popov.

D-21. Discussion of Paper, **Maximum Load Capacity of Bailey Bridges,** by Robert B. Stegmaier, Jr.

67. Model and Prototype Studies of Sand Traps, by Ralph L. Parshall.

68. International Cartography, by Robert H. Randall.

69. Valuation and Depreciation Related to Income Tax, by Maurice R. Scharff.

70. Regime Theory for Self-Formed Sediment-Bearing Channels, by T. Blench.

71. Rectification of the Papaloapan River in Mexico, by Reynaldo Schega.

D-24. Discussion of Paper, **Buckling of Rigid-Jointed Plane Trusses,** by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman.

Third Notice

72. Design of Large Coal Bunkers, by Paul Rogers. Design procedure is presented for large capacity coal bunkers. Coal pressures by the shallow bin formula and by modified deep bin formulas are reviewed, pressures on inclined wall analyzed, and values tabulated. Bunker walls are presented as flexible plates and inward forces analyzed. Unbalanced forces due to unsymmetrical layouts are investigated. The paper advocates design by continuity for the stiffeners, and the inclusion of the bunker plates in the design of stiffeners is emphasized. Several illustrations and tables are included to facilitate quick and economical design. (Available July 1.)

73. Health Implications of Air Pollution, by J. J. Bloomfield. The need for control of air pollution is especially urgent in view of the increasing industrial activity with attendant pollution of the atmosphere. Studies have shown a definite relationship of air pollution to health. The study of the Donora smog of October 1948, during which 6,000 persons were affected (20 of them fatally) confirmed the acute threat of air pollution and pointed the way to consideration of long-range, or chronic, effects. Reduction of the pollution load is not always economically feasible with available devices, but research and restriction should aid in the solution of the problem. The engineer in industry can play an active part in this rapidly expanding field. (Available July 1.)

74. Acceptable Standards for Natural Waters Used for Bathing, by Charles R. Cox. Increasing interest in the public health aspects of bathing water quality has led to a study of standards suitable for the control of these waters. Quantitative bacteriological standards are difficult to apply without supplementary sanitary surveys and the exercise of seasoned administrative judgment. Methods of evaluating pollution have not developed sufficiently to permit assuming absolute standards. The connection between pollution of bathing waters and illness of the rising population has not been investigated thoroughly. (Available July 1.)

75. Base Course Drainage for Airport Pavements, by Arthur Casagrande and William L. Shannon. Observations on a number of airfields are described illustrating the principal causes for the saturation of base courses of airfield pavements. A theoretical analysis of the drainage of saturated base courses is presented and working formulas are recommended. Laboratory tests on fluid models and full-scale field tests are described and their results compared with the theoretical formulas. The recommended design procedure is illustrated by means of an example. (Available July 1.)

76. Model Tests Using Low-Velocity Air, by James W. Ball. The use of low-velocity air testing to solve flow problems pertaining to hydraulic conduit systems and equipment is presented. How this method of testing may be used as an inexpensive expedient in obtaining complete or partial solutions to hydraulic problems is outlined. Limiting velocities, advantages, disadvantages, precautions, comparison with hydraulic tests, and specific examples are discussed. (Available July 1.)

D-25-K. Discussion of Paper, **Uplift Pressures in Concrete Dams,** by Kenneth B. Keener. The original paper, published in June

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3. Members' accounts will be charged at 25¢ each for orders exceeding 40 copies in a fiscal year. Charges for excess copies or for subscriptions will be included on the 1952 dues bills.

4. Non-members of the Society may order copies of PROCEEDINGS papers by letter with remittance of 50¢ per copy; members of Student Chapters 25¢ per copy.

5. Discussions of each paper, with author's closure, also will be published as a Separate and must be ordered in the same manner as other Separates, except that no charge will be made for the discussions of a paper previously ordered. The order form will list available discussions of papers. Discussions will be numbered to agree with the basic paper.

Standing orders for all Separate papers, including their Discussions, in any calendar year, may be entered at the following annual rates: Members of ASCE, $3.00 (beginning January 1, 1952 $5.00); members of Student Chapters, $5.00; non-members, $10.00, plus foreign postage charge of $.75; libraries, $5.00.

TRANSACTIONS. All PROCEEDINGS papers, with discussions, will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the currently established annual subscription rates.

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1950, described the installation and location of equipment used to observe uplift in concrete dams and gave methods of relieving this uplift. Discussers are: Ross M. Riegel, William P. Creager, A. Warren Simonds, Fairfax D. Kirn, Serge Leliavsky Bey, A. M. Davison, Duff Abrams, and Kenneth B. Keener. (Available July 1.)

D-29. Discussion of Paper, **Sedimentation Studies at Conchas Reservoir in New Mexico,** by D. C. Bondurant. The original paper, published in August 1950, presented data on the form and extent of sediment deposits at Conchas Reservoir and emphasized the importance of considering sedimentation in reservoir design. Discussers are: T. Blench and D. C. Bondurant. (Available July 1.)

D-32. Discussion of Paper, **Effect of Skew Angle on Rigid-Frame Reactions,** by Walter C. Boyer. The original paper, published in September 1950, presented methods of analysis of the skewed rigid-frame bridge that reduce the arduous labor of design of such structures. Discussers are: D. A. Nettleton, Maurice Barron, and Walter C. Boyer. (Available July 1.)

Second Notice

77. Buckling Stresses for Flat Plates and Sections, by Elbridge Z. Stowell, George J. Heimerl, Charles Libove, and Eugene E. Lundquist. The results of extensive studies in the buckling of flat unstiffened plates conducted in the field of aeronautics are surveyed. The single plate loadings of compression and shear are considered as well as integral flat-plate loadings of compression only. The buckling stresses are given in the form of a non-dimensional chart for the elastic stress range. (Available August 1.)

78. River Channel Roughness, by Hans A. Einstein and Nicholas L. Barbarossa. The total friction developed on the alluvial bed of a natural river can be described as the sum of a "surface drag" and of a "shape resistance." The surface drag may be determined from conventional friction formulas but the shape or bar resistance is given as a function of the sediment transport. An easily applicable relationship is presented in the form of a graph, from which the shape resistance can be determined. This curve has been derived from a wide variety of measurements in natural rivers and is generally applicable to natural rivers. (Available August 1.)

79. Stage Predictions for Flood Control Operations, by Ralph E. King. The problems relative to the prediction of stages in the lower Mississippi River Valley during flood periods are the subject of this paper. The development of various forecasting techniques and the advantages and limitations of these techniques with respect to use on the Mississippi River are briefly outlined. Methods used by the Stage Prediction Section of the Mississippi River Commission are explained, with emphasis being given to the method used for reaches which are influenced by inflows from major tributaries. Conclusions as to the type of forecasting procedure necessary to obtain reliable stage predictions on the lower Mississippi River are presented. (Available August 1.)

80. Mississippi River Valley Geology Relation to the River's Regimen, by Harold N. Fisk. A brief description of the geology of the alluvial valley of the lower Mississippi River is given and major changes in stream activity are described. The nature and geological development of the alluvial deposits are discussed and the close adjustment between these bed and bank materials and channel characteristics emphasized. Alluvial plain features show that this adjustment has been maintained since the sea reached its present level several thousand years ago. During this period the river has developed and abandoned several meandering courses. The existing Atchafalaya-Mississippi relationships suggests an early stage in the diversion of the river to a new course. (Available August 1.)

81. Petenwell Hydroelectric Project, by E. Montford Fucik. This project, located on the Wisconsin River, involved unusual design problems because of the 100 ft deep sand foundation. The spillway and powerhouse are founded on this sand, and the basic design criteria, as well as the cross sections of the structures are given. Recorded water pressures under the completed structures, and comparisons of model test and prototype scour patterns downstream from the spillway, are shown. The earth dams, built of sand, are described, and recorded seepage lines are compared with the flow net studies. The use of hydraulic spillway gate hoists is also described. (Available August 1.)

First Notice

82. Pressures in a Shallow Rectangular Bin, by Raymond L. Moore and J. R. Shaw. The estimation of the distribution and magnitude of the pressure forces is important in the design of shallow bins that support granular materials, especially if the bin is subject to impact or vibration. This paper reports and analyzes the results of a series of tests on such materials as wheat, gravel, and cement in loose and vibrated conditions. (Available September 1.)

83. Waterway Traffic on the Great Lakes, by John R. Hardin. The Great Lakes are an important artery of commerce serving an area rich in natural resources and industrial facilities. The shipping channels and harbors are splendid examples of the type of improvement developed and maintained by the Great Lakes Division of the Corps of Engineers. Statistics on the magnitude of commerce are given, and the St. Lawrence Seaway Project is discussed. (Available September 1.)

84. Longitudinal Mixing Measured by Radioactive Tracers, by Harold A. Thomas, Jr., and Ralph S. Archibald. Short-circuiting of flow in streams, conduits, lakes, and tanks occurs when some portions of the liquid pass through with velocities considerably greater than the mean velocity. The degree of short-circuiting has an important effect upon the efficiency of water and sewage treatment plants and upon the capacity of streams and lakes for handling pollutional loads. A new tool for assessing the magnitude of longitudinal mixing is use of radioactive tracers. These materials show many advantages over commonly used tracers and make possible precise and sensitive measurements. The paper describes procedures and results and advances the theory of the test. Examples are given indicating the magnitude and effect of mixing. (Available September 1.)

85. Resinous Ion Exchanges in Water Treatment, by William W. Aultman. The application of the newer ion exchanges in the water treatment field is discussed in this paper. The types and uses of many ion exchange materials are summarized and their capacities and costs compared. Demineralization and treatment of industrial process waters are further applications that are described. (Available September 1.)

86. Ground-Water Phenomena Connected with Spreading, by Paul Baumann. Water conservation by the diversion of clear stream flow to off-channel areas is practiced in Los Angeles County, California. This water is caused to percolate into the ground and is added to the ground-water supply. The characteristics and operation of this spreading system are outlined and theoretical expressions derived. The theory is also compared with results of model basin studies. (Available September 1.)

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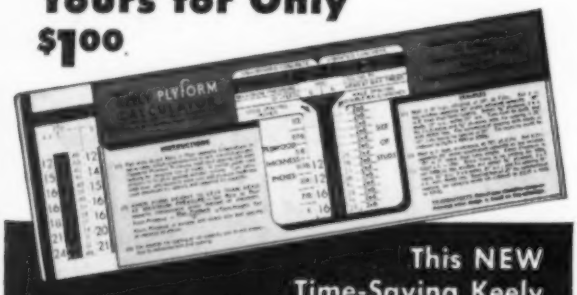

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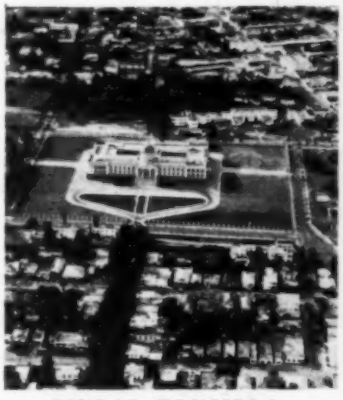

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